

AD-A096 417

AIR FORCE ENVIRONMENTAL TECHNICAL APPLICATIONS CENTER--ETC F/G 4/2
VANDENBERG AIR FORCE BASE 'WINDS' COMPARISON STUDY; WIND TOWERS--ETC(U)
MAR 79 J R CLARK; J A JACKSON
UNCLASSIFIED USAFETAC/PR-79/001

SBIE-AD-E850 019

NL

1 OF 1
AD-A096 417

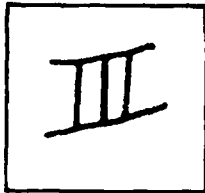
END
DATE
FILMED
4-84
DTIC

PHOTOGRAPH THIS SHEET

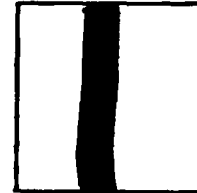
AD-E850 019

AD A096417

DTIC ACCESSION NUMBER



LEVEL



INVENTORY

USAFETAC/PR-79/001

DOCUMENT IDENTIFICATION

Mar. 79

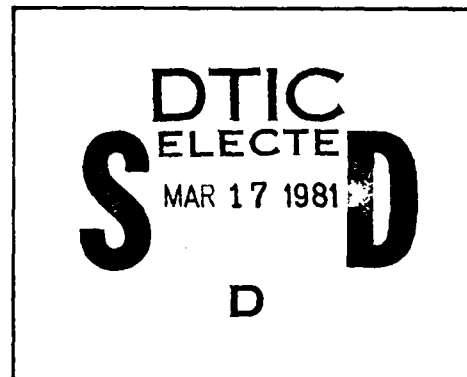
DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

DISTRIBUTION STATEMENT

ACCESSION FOR	
NTIS	GRA&I
DTIC	TAB
UNANNOUNCED	
JUSTIFICATION	
BY	
DISTRIBUTION /	
AVAILABILITY CODES	
DIST	AVAIL AND/OR SPECIAL
A	

DISTRIBUTION STAMP



DATE ACCESSIONED

81 3 17 001

DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2

AD-E850019

UNITED STATES AIR FORCE
AIR WEATHER SERVICE (MAC)

USAF ENVIRONMENTAL
TECHNICAL APPLICATIONS CENTER

SCOTT AIR FORCE BASE, ILLINOIS 62225



AD A096417

USAFETAC/PR-79/001

VANDENBERG AIR FORCE BASE
'WINDS' COMPARISON STUDY

Wind Towers 300 and 301

James R. Clark, Capt, USAF
Julius A. Jackson, Jr., Capt, USAF

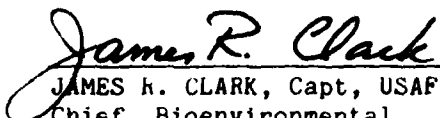
March 1979

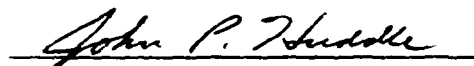
Approved for public release; distribution unlimited.

REVIEW AND APPROVAL STATEMENT

This report approved for public release. There is no objection to unlimited distribution of this report to the public at large, or by DDC to the National Technical Information Service (NTIS).

This technical report has been reviewed and is approved for publication.


JAMES R. CLARK, Capt, USAF
Chief, Bioenvironmental
Operations Section


JOHN P. HUDDLE, Maj, USAF
Assistant Chief
Global Environmental
Applications Branch

FOR THE COMMANDER


WALTER S. BURGMANN
Scientific and Technical
Information Officer (STINFO)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER USAFETAC/PR-79/001	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) VANDENBERG AIR FORCE BASE 'WINDS' COMPARISON STUDY; Wind Towers 300 and 301.		5. TYPE OF REPORT & PERIOD COVERED
7. AUTHOR(s) James R. Clark, Captain, USAF Julius A. Jackson, Jr., Captain, USAF		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Air Force Environmental Technical Applications Center Scott AFB IL 62225		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS US Air Force Environmental Technical Applications Center Scott AFB IL 62225		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE March 1979
		13. NUMBER OF PAGES 31
		15. SECURITY CLASS (of this report) Unclassified
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Meteorology Vandenberg AFB Temperature Tower Mounted Sensors Wind California (WINDS) meteorological data statistical data		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Vandenberg AFB "WINDS" Tower 301 will provide the meteorological data to support the launch of the Space Shuttle. The data from Tower 301 have a shorter period of record (POR) than data from Tower 300 which is located a few miles north. For specified wind speed categories, the means and standard deviations of the differences in wind direction, wind speed, and temperature are computed for the towers by season, directional range, day/night, and tower level. Also, the percentage frequency of occurrences		

20. ABSTRACT (cont.)

of temperatures for 15 wind speed categories are calculated. Tower 301 data were correlated with Tower 300 data. The feasibility of creating a bogus POR for Tower 301 using the data from Tower 300 was investigated. The correlation of statistically produced bogus Tower 301 data with the actual Tower 301 data was slightly better than the correlation with the Tower 300 data.

PREFACE

The United States Air Force Environmental Technical Application Center (USAFETAC) prepared this report in answer to a request from the Space and Missile Test Center (SAMTEC), Vandenberg AFB, California, to provide climatological studies of the winds and temperatures at micrometeorological (micromet) Towers 300 and 301 and to study the feasibility of combining these data from the two towers to extend the period of record (POR) of Tower 301 data. In addition to a description of the programs utilized for the climatological summaries, this report gives an extensive discussion of the regression procedures used to create "bogus" data for a tower from the data of the other tower. It also presents graphs of the seasonal comparisons of the data from Towers 300 and 301. First Lieutenant Tamzy J. Cunningham and Major Calvin C. Naegelin were the original project analysts who wrote the program designs for the initial climatological summaries.

If this report is incorporated into another report by any agency, please give USAFETAC proper credit and furnish USAFETAC a copy of the new report if possible. For further information please contact USAFETAC.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
GEOGRAPHY OF SITE.	1
DATA PROBLEMS.	1
PROGRAM DESCRIPTIONS	7
Wind Speed Versus Temperature (ENBWSVTP)	7
External Tank Icing (ENBWTETI)	7
Wind Tower Comparison (ENBWTCMP)	9
Wind Tower Correlation (ENBWTCOR).	9
ENBWTREM	9
Method of Analysis	9
Regression Analysis.	11
Creating Bogus Data.	11
RESULTS.	11
Comparison of Actual Data.	11
Comparison of Bogus Data	13
CONCLUSION	21
Actual Data Comparisons.	21
Bogus Data Comparisons	21
REFERENCES	22
APPENDIX A REGRESSION TECHNIQUE	23

LIST OF ILLUSTRATIONS

Figure 1	Prominent Terrain Features, South Vandenberg	6
Figure 2	Example of ENBWSVTP Output	8
Figure 3	Example of ENBWTETI Output	10
Figure 4	Example of ENBWTCOR Output	10
Figure 5	Correlation of U-Component (02-13Z) at Levels 1-5.	14
Figure 6	Correlation of U-Component (14-01Z) at Levels 1-5.	14
Figure 7	Correlation of V-Component (02-13Z) at Levels 1-5.	15
Figure 8	Correlation of V-Component (14-01Z) at Levels 1-5.	15
Figure 9	Correlation of Temperature (02-13Z) at Levels 1-5.	16
Figure 10	Correlation of Temperature (14-01Z) at Levels 1-5.	16
Figure 11	Example of Summer Night Bogus Data	17
Figure 12	Example of Spring Night Bogus Data	18
Figure 13	Example of Summer Day Bogus Data	19
Figure 14	Example of Winter Day Bogus Data	20

LIST OF TABLES

Table 1	Tower 300 Observation Audit.	2
Table 2	Tower 301 Observation Audit.	4
Table 3	Towers 300 and 301 Observation Frequency	7
Table 4	Correlation Coefficients for Towers 300 and 301.	12
Table 5	Comparisons of Correlation Coefficients for Towers 300 and 301	21

VANDENBERG AIR FORCE BASE
'WINDS' COMPARISON STUDY

Wind Towers 300 and 301

INTRODUCTION

The design of the Space Transportation System (STS) launch facility and components of the space shuttle are sensitive to environmental factors. The best climatological summaries of temperature, wind speed, and wind direction are essential for the systems studies and analyses. The data used in this project are from the Weather Information Network and Display Systems (WINDS) at Vandenberg AFB, California. Tower 301, the wind tower supporting the launch site, has a short period of record (POR) compared to that for Tower 300. The purpose of this project was to investigate the existing POR, perform several climatological studies, and determine the feasibility of expanding the POR for Tower 301 using data from Tower 300. Three of the five computer programs developed during this project were designed to answer specific problems for other Space and Missile Test Center (SAMTEC) studies.

GEOGRAPHY OF SITE

The STS launch facility, Space Launch Complex 6 (SLC-6), and micrometeorological (micromet) WINDS Tower 301 (elevation 380 ft) are located in the southern foothills of the Santa Ynez Mountains in South Vandenberg's Punta De La Concepcion area, approximately 1 statute mile east of Point Arguello (Figure 1). Tranquillon Ridge and Cypress Ridge, with peaks ranging from 1000-1600 feet, border the launch facility and Tower 301 on the east, northeast, and southeast. Towards the north, the south, and the west the Santa Ynez foothills slope into the Pacific Ocean. Oceanic wind flow influences the tower's instruments from the east-southeast clockwise to the north-northeast. The wind flow from the remaining quadrant is greatly influenced by the Santa Ynez Mountains.

WINDS Tower 300 (elevation 385 ft) is located approximately 4 statute miles north-northeast of Tower 301 in the northern foothills of the Santa Ynez Mountains. The steep-sided La Honda Canyon, approximately 800 feet deep and 1-1/2 miles wide, is located midway between Towers 300 and 301. To the north and west of Tower 300 the terrain gradually slopes into the ocean; to the northeast the terrain slopes into the low-lying area of Lompoc Terrace. Ridges, ranging in height from 800-1000 feet, border Tower 300 on the south and east. Oceanic wind flow influences the tower from the south-southwestern to the north-northwestern directions. Continental wind flow characterizes the remaining directions.

DATA PROBLEMS

The micromet system is operated and maintained by the Space and Missile Test Center (SAMTEC). The data provide environmental information required for planning, support systems and facilities. The United States Air Force Environmental Technical Applications Center (USAFETAC) collects, stores, retrieves, and processes the micromet data for studies and analyses needed to support customer requirements.

Tables 1 and 2 show the number of observations available at Towers 300 and 301, respectively. Data are collected once per second and averaged over a period of time. The basic time period is 30 minutes. In the audit, an observation is defined as a date/time group. Additional data may be present for one to five levels to include wind speed, wind direction, wind gusts, and temperature.

Table 1. Tower 300 Observation Audit.

BLKSTN	TWR	YRMC	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
723930	300	7106	38	36	38	40	40	40	40	40	40	40	40	38	38	38	38	38	38	38	37	38	40	38	38	26
723930	300	7107	51	51	54	56	58	58	51	53	61	62	60	58	58	58	58	58	52	49	52	48	50	40	41	43
723930	300	7108	23	25	26	26	25	28	30	32	29	28	28	28	28	28	28	28	26	24	28	28	22	19	23	23
723930	300	7109	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0
723930	300	7110	38	37	37	39	44	39	41	45	38	39	39	38	38	36	36	37	38	35	42	44	49	38	39	38
723930	300	7111	59	54	54	53	57	56	56	52	55	54	54	58	58	58	55	53	62	63	59	57	56	53	55	57
723930	300	7112	33	34	34	34	33	34	34	34	34	34	34	34	34	34	34	34	32	30	29	30	30	21	27	30
723930	300	7201	41	40	40	37	37	38	40	42	40	40	38	38	38	38	38	41	43	42	41	44	54	54	57	55
723930	300	7202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	2
723930	300	7203	50	50	50	45	48	48	48	46	46	48	48	48	48	47	46	46	44	40	44	44	46	46	45	45
723930	300	7204	28	25	24	27	29	32	29	26	25	23	23	22	20	15	18	23	25	28	31	30	27	27	29	29
723930	300	7205	24	28	26	26	24	26	28	26	26	26	26	26	26	24	25	26	25	23	24	28	28	27	24	22
723930	300	7206	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	17	17	25	17	14	19	20	20
723930	300	7207	54	54	54	56	57	56	57	60	60	59	58	57	56	56	58	57	53	52	57	58	54	58	55	52
723930	300	7208	43	43	43	39	38	41	42	45	48	48	46	46	46	46	46	46	46	46	43	45	47	48	47	48
723930	300	7209	43	43	43	41	42	42	44	46	46	46	46	46	46	46	46	47	49	46	44	45	48	46	45	44
723930	300	7210	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4
723930	300	7211	40	45	45	44	42	44	44	42	43	44	43	42	41	38	36	41	44	47	44	50	47	46	48	52
723930	300	7212	22	20	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7213	22	22	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7214	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0
723930	300	7215	37	41	42	43	44	44	45	46	46	46	46	46	46	46	46	46	46	51	48	49	49	48	48	47
723930	300	7216	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4
723930	300	7217	40	45	45	44	42	44	44	42	43	44	43	42	41	38	36	41	44	47	44	50	47	46	48	52
723930	300	7218	22	20	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7219	22	22	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7220	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0
723930	300	7221	37	41	42	43	44	44	45	46	46	46	46	46	46	46	46	46	46	51	48	49	49	48	48	47
723930	300	7222	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4
723930	300	7223	40	45	45	44	42	44	44	42	43	44	43	42	41	38	36	41	44	47	44	50	47	46	48	52
723930	300	7224	22	20	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7225	22	22	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7226	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0
723930	300	7227	37	41	42	43	44	44	45	46	46	46	46	46	46	46	46	46	46	51	48	49	49	48	48	47
723930	300	7228	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4
723930	300	7229	40	45	45	44	42	44	44	42	43	44	43	42	41	38	36	41	44	47	44	50	47	46	48	52
723930	300	7230	22	20	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7231	22	22	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7232	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0
723930	300	7233	37	41	42	43	44	44	45	46	46	46	46	46	46	46	46	46	46	51	48	49	49	48	48	47
723930	300	7234	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4
723930	300	7235	40	45	45	44	42	44	44	42	43	44	43	42	41	38	36	41	44	47	44	50	47	46	48	52
723930	300	7236	22	20	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7237	22	22	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7238	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0
723930	300	7239	37	41	42	43	44	44	45	46	46	46	46	46	46	46	46	46	46	51	48	49	49	48	48	47
723930	300	7240	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4
723930	300	7241	40	45	45	44	42	44	44	42	43	44	43	42	41	38	36	41	44	47	44	50	47	46	48	52
723930	300	7242	22	20	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7243	22	22	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7244	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0
723930	300	7245	37	41	42	43	44	44	45	46	46	46	46	46	46	46	46	46	46	51	48	49	49	48	48	47
723930	300	7246	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4
723930	300	7247	40	45	45	44	42	44	44	42	43	44	43	42	41	38	36	41	44	47	44	50	47	46	48	52
723930	300	7248	22	20	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7249	22	22	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7250	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0
723930	300	7251	37	41	42	43	44	44	45	46	46	46	46	46	46	46	46	46	46	51	48	49	49	48	48	47
723930	300	7252	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4
723930	300	7253	40	45	45	44	42	44	44	42	43	44	43	42	41	38	36	41	44	47	44	50	47	46	48	52
723930	300	7254	22	20	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7255	22	22	20	20	21	22	25	26	27	27	26	26	24	24	24	24	16	16	16	18	17	16	17	18
723930	300	7256	2	2	2	2	2																			

Table 1. Tower 300 Observation Audit (Cont'd).

BLKSTN	TWR	VRMU	00	01	02	03	04	05	06	07	08	09	10	11	12	12	14	15	16	17	18	19	20	21	22	23
723930	300	7704	49	50	50	50	50	51	52	52	51	50	50	50	50	50	48	51	46	37	38	35	37	37	36	39
723930	300	7705	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
723930	300	7706	58	58	59	59	59	58	58	58	58	58	58	58	58	58	56	56	49	48	51	55	49	50	54	56
723930	300	7707	54	53	53	54	56	56	56	56	56	56	56	56	54	54	55	53	51	50	52	52	49	51	54	51
723930	300	7708	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
723930	300	7709	60	60	59	57	56	58	60	60	60	60	60	60	60	60	60	59	51	52	58	59	58	52	58	60
723930	300	7710	56	56	56	54	54	55	56	56	56	56	56	56	56	56	56	52	51	56	56	60	54	52	56	58
723930	300	7711	52	52	52	50	50	53	50	50	50	50	50	48	48	48	44	48	51	52	51	52	50	52	50	48
723930	300	7712	47	44	42	43	44	43	40	40	40	38	38	38	38	38	38	42	41	41	38	41	42	44	42	45
723930	300	7801	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
723930	300	7802	48	48	48	47	46	46	46	48	48	46	46	46	46	46	44	42	45	43	39	38	44	47	49	50
723930	300	7803	51	50	50	52	52	52	52	52	52	51	50	50	50	50	50	54	53	54	51	51	53	56	56	54
723930	300	7804	56	56	58	58	58	58	58	58	58	58	58	58	58	58	58	58	60	53	55	51	52	51	50	54
723930	300	7805	48	46	46	46	46	46	46	46	46	46	46	46	44	44	42	39	37	31	32	33	35	32	39	45

JOB COMPLETED. U TAPE ERRORS 53667 UBS EXTRACTED

Table 2. Tower 301 Observation Audit.

YRMO	TWR	BLKSTN	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
723930	301	6607	17	19	17	18	17	18	17	16	16	17	16	16	17	17	18	19	20	20	15	18	19	21	22	23
723931	301	6608	24	25	25	24	24	24	24	24	24	25	23	22	25	24	23	22	23	24	25	24	24	22	25	23
723932	301	6609	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
723933	301	6605	30	30	30	30	30	30	30	30	30	30	29	30	30	30	30	30	30	30	29	29	29	29	29	29
723934	301	6606	27	26	26	26	27	27	27	27	27	26	27	26	27	26	26	26	26	26	26	27	27	27	27	27
723935	301	6607	27	27	27	27	26	26	26	26	26	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
723936	301	6608	21	31	31	31	31	31	31	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723937	301	6609	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
723938	301	6610	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723939	301	6611	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
723940	301	6612	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723941	301	6613	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
723942	301	6614	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723943	301	6615	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
723944	301	6616	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723945	301	6617	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
723946	301	6618	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723947	301	6619	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
723948	301	6620	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723949	301	6608	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
723950	301	6605	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723951	301	6610	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723952	301	6611	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
723953	301	6612	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
723954	301	7501	2	0	0	0	5	7	6	6	5	2	2	2	3	4	4	4	6	3	7	10	12	11	9	5
723955	301	7502	48	46	41	36	42	41	41	44	43	42	44	44	43	41	38	38	40	37	39	40	36	38	36	34
723956	301	7503	30	31	30	32	30	28	29	27	26	26	26	26	26	25	26	25	26	23	29	33	28	31	32	31
723957	301	7504	50	49	46	48	47	46	48	46	46	46	46	44	44	44	44	44	44	44	48	51	50	48	45	
723958	301	7505	52	52	52	52	52	52	52	52	52	51	50	50	50	50	50	47	44	39	43	45	44	46	48	49
723959	301	7506	54	52	52	52	54	56	56	56	56	56	56	56	54	54	55	54	54	53	52	49	53	54	53	
723960	301	7507	43	42	42	40	40	43	40	40	40	40	40	40	40	40	38	38	42	40	37	41	41	41	41	41
723961	301	7508	62	63	62	62	62	62	62	62	62	62	62	62	62	62	61	60	63	59	58	58	58	57	62	
723962	301	7509	55	54	52	52	56	54	56	52	54	54	54	54	54	54	54	54	52	47	48	50	49	55	55	
723963	301	7510	30	30	30	30	29	28	28	28	28	28	28	28	28	26	26	26	26	25	25	28	29	30	28	
723964	301	7511	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	23	24	23	24	24	24	
723965	301	7512	62	62	62	62	62	62	62	62	62	63	62	62	60	59	58	58	52	58	62	59	60	58	57	
723966	301	7513	54	52	52	52	50	50	50	50	50	51	50	50	49	49	49	46	45	40	40	41	41	47	43	
723967	301	7514	54	52	52	52	50	50	50	50	50	51	50	50	49	49	49	46	45	40	40	41	41	47	43	

Table 2. Tower 301 Observation Audit (Cont'd).

ALSTN	TWR	YRMO	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23
723930	301	7610	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
723930	301	7611	38	38	38	37	38	37	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
723930	301	7612	50	50	50	50	51	50	51	49	50	50	50	50	50	50	50	50	50	50	50	50	50	50	
723930	301	7701	22	21	20	21	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	
723930	301	7702	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
723930	301	7703	12	12	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
723930	301	7704	48	50	50	50	51	52	52	51	50	50	50	50	50	50	50	50	50	50	50	50	50	50	
723930	301	7705	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
723930	301	7706	58	58	59	59	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	
723930	301	7707	54	53	53	54	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	
723930	301	7708	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
723930	301	7709	60	60	59	57	56	58	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	
723930	301	7710	56	56	56	54	54	55	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	
723930	301	7711	52	52	52	50	52	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	
723930	301	7712	47	44	42	43	44	43	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	
723930	301	7801	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
723930	301	7802	48	48	48	47	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	
723930	301	7803	51	50	50	52	52	52	52	52	51	50	50	50	50	50	50	50	50	50	50	50	50	50	
723930	301	7804	56	56	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	
723930	301	7805	48	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	

ALB COMPLETE.

STAGE REMOVS

COLUS CDS EXTRACTED

JOB COMPLETED.

0 TAPC REMOVED 00135 CUS EXTENDED

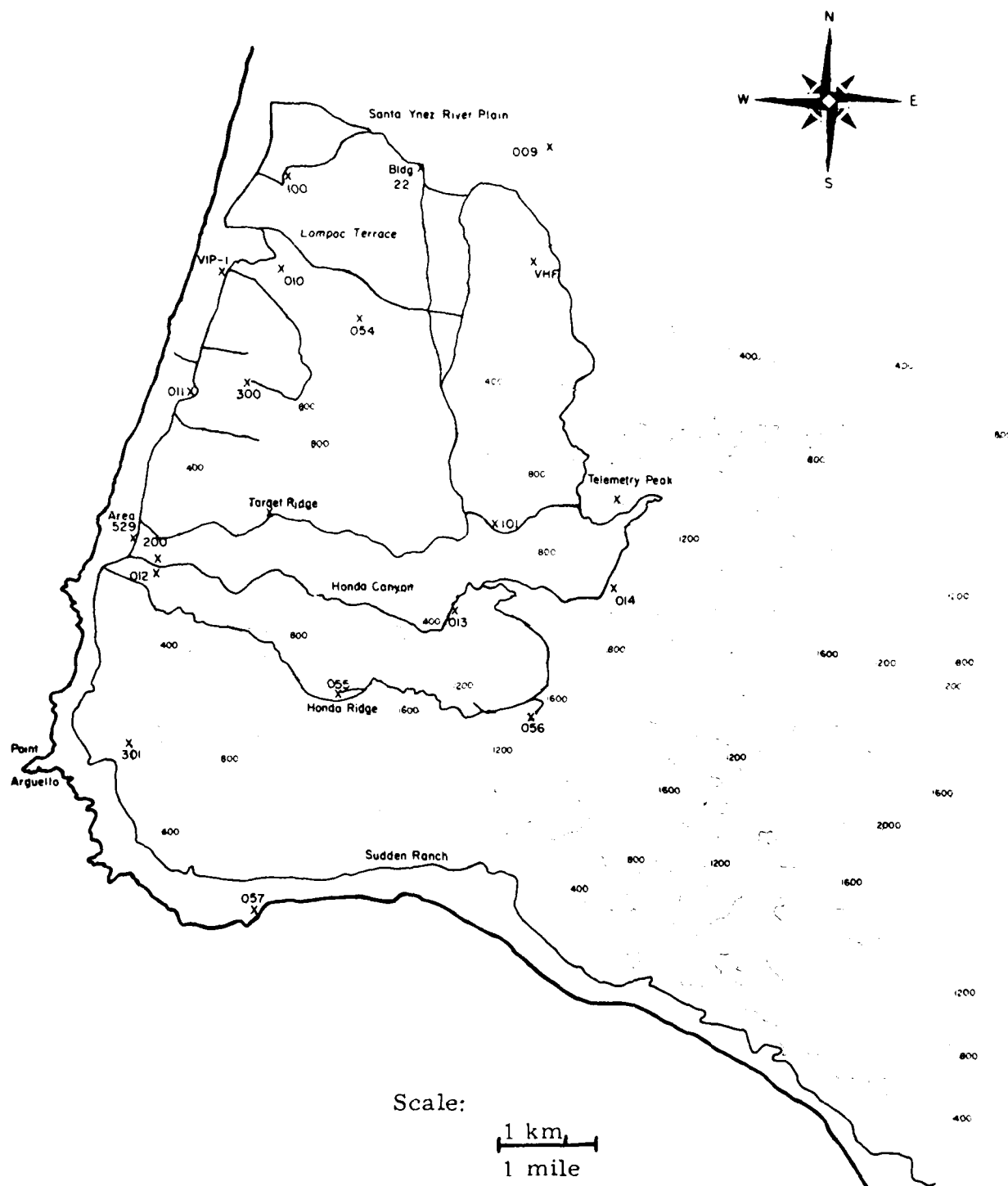


Figure 1. Prominent Terrain Features, South Vandenberg (Hinds and Nickola, 1968).

Tower 300 data are available for the period June 1971 to May 1978. Two observations per hour are available except for a short period from 1 June 1971 to 22 June 1971 when 5- and 15-minute observations were taken. May 1978 was the last month used in this study.

Tower 301 data from February 1966 to December 1968 were not used in this study due to the lack of temperature information. No data were available from 1 June 1969 until 23 January 1975. Data recorded from 23 January 1975 to 12 April 1975 contain only date/time groups. After April 1975 an observational count in the 60s indicated the maximum data available. From April 1975 through May 1978 miscellaneous months are missing or have low observation counts. May 1978 was the termination point for data used in this project. Table 3 gives a breakdown of the frequency of observations at the two towers.

Table 3. Towers 300 and 301 Observation Frequency.

<u>TOWER</u>	<u>DATE</u>	<u>FREQUENCY</u>
300	14 Jun 71-22 Jun 71	Hourly, 5 min
	23 Jun 71-31 May 78	Hourly, Hour + 30 min
301	02 Feb 66-31 May 67	Hourly
	01 Jun 67-03 May 68	Hourly, Hour + 10 min
	04 May 68-31 Dec 68	Hourly
	23 Jan 75-31 May 78	Hourly, Hour + 30 min

By studying the audit one can see that although there is a lengthy POR for both towers, the usable data are limited. The POR is further decreased by some observations containing only a date/time group with no accompanying meteorological data or few levels. This short POR is the primary reason for attempting to supplement Tower 301 data with data from Tower 300.

PROGRAM DESCRIPTIONS

Five computer programs were developed: ENBWSVTP, ENBWTETI, ENBWTCMP, ENBWTCOR, and ENBWTREM. The first two programs produce specific climatological data summaries. The third program reformats the data for use in the fourth and fifth programs, which also produce specific climatological data summaries. The first four programs will be discussed in this section. Due to the complexity and scope of the fifth program, it will be examined in a separate section.

The climatological studies were done for five levels (12, 54, 102, 204, and 300 ft), the four seasons, and the four wind-directional sectors (030°-119°, 120°-209°, 210°-299°, 300°-029°). Each summary except for the ENBWSVTP output was computed for daytime (1400-0100Z) and nighttime (0200-1300Z). The ENBWSVTP output is summarized in three-hour blocks. In addition to the standard paper copies, microfiche copies are available. Due to the volume of data involved, only examples are shown in this report.

Wind Speed Versus Temperature (ENBWSVTP)

This program assists in planning the design of support facilities, systems, and procedures to be used in launching the space shuttle. The program calculates percentage frequency of occurrence of 15 wind speed and 30 temperature categories. Statistics were computed for each of the five levels for Towers 300 and 301. An example of the annual table for all hours and wind directions for Tower 301 is shown in Figure 2. The format of the seasonal table is identical. The POR for Tower 300 was 14 June 1971-30 September 1977 and for Tower 301, 13 February 1975-21 November 1977.

External Tank Icing (ENBWTETI)

The formation of frost or ice on the space shuttle's external fuel tank is a critical problem. The data from this program can be used to determine the frequency and severity of meteorological conditions favorable to icing at Space Launch Complex (SLC-6).

FRAME J12
TOWER NUMBER: 301
LEVEL: 4
VANDENBURG WIND TOWER 301
ANNUAL
WIND DIRECTION: ALL
HOURS: ALL

WIND SPEED VERSUS TEMPERATURE													
PERCENTAGE FREQUENCY OF OCCURRENCE													
(FROM 30-MINUTE MEANS)													
TEMPERATURE (DEG F)	>=56	>=50	>=44	>=38	>=32	WIND SPEED (KTS)	>=26	>=23	>=20	>=17	>=14	>=11	>=8
>=100	0	0	0	0	0	0	0	0	0	0	0	0	0
>=95	0	0	0	0	0	0	0	0	0	0	0	0	0
>=90	0	0	0	0	0	0	0	0	0	0	0	0	0
>=85	0	0	0	0	0	0	0	0	0	0	0	0	0
>=80	0	0	0	0	0	0	0	0	0	0	0	0	0
>=75	0	0	0	0	0	0	0	0	0	0	0	0	0
>=70	0	0	0	0	0	0	0	0	0	0	0	0	0
>=65	0	0	0	0	0	0	0	0	0	0	0	0	0
>=60	0	0	0	0	0	0	0	0	0	0	0	0	0
>=58	0	0	0	0	0	0	0	0	0	0	0	0	0
>=56	0	0	0	0	0	0	0	0	0	0	0	0	0
>=54	0	0	0	0	0	0	0	0	0	0	0	0	0
>=52	0	0	0	0	0	0	0	0	0	0	0	0	0
>=50	0	0	0	0	0	0	0	0	0	0	0	0	0
>=48	0	0	0	0	0	0	0	0	0	0	0	0	0
>=46	0	0	0	0	0	0	0	0	0	0	0	0	0
>=44	0	0	0	0	0	0	0	0	0	0	0	0	0
>=42	0	0	0	0	0	0	0	0	0	0	0	0	0
>=40	0	0	0	0	0	0	0	0	0	0	0	0	0
>=38	0	0	0	0	0	0	0	0	0	0	0	0	0
>=36	0	0	0	0	0	0	0	0	0	0	0	0	0
>=34	0	0	0	0	0	0	0	0	0	0	0	0	0
>=32	0	0	0	0	0	0	0	0	0	0	0	0	0
>=30	0	0	0	0	0	0	0	0	0	0	0	0	0
>=28	0	0	0	0	0	0	0	0	0	0	0	0	0
>=26	0	0	0	0	0	0	0	0	0	0	0	0	0
>=24	0	0	0	0	0	0	0	0	0	0	0	0	0
>=22	0	0	0	0	0	0	0	0	0	0	0	0	0
>=20	0	0	0	0	0	0	0	0	0	0	0	0	0
>=0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL OBS	11321												

FOR: 13 FEB 75 - 21 NOV 77

Figure 2. Example of ENBMSVTP Output.

The program computes statistical data for wind speed, wind direction, and temperature using data for a single tower. Two observations for the same level, separated in time by the user-specified interval, are located, and the differences in wind speed, wind direction, and temperature for the specified time interval are computed. The difference is defined as the later value minus the earlier value. The mean and the standard deviation of the differences for all three parameters are calculated for the respective 11 speed categories. The values are summarized for each level, wind directional sector, and season. An all-directional and seasonal summary is also included. Figure 3 is an example of the ENBWTETI output. Only Tower 301 data for 23 January 1975-24 May 1978 were used.

Wind Tower Comparison (ENBWTCMP)

The third program provides an intermediate step to merge the data from Towers 300 and 301 together on a tape. This output is the input for the comparison and regression analyses. The program reads the POR tapes from Towers 300 and 301 to obtain concurrent observations within the desired hour spans. If any data are missing, the entire observation is discarded. The output is recorded on two different tapes depending upon which hour span the observation falls into. The final output tape contains concurrent observations of wind direction, wind speed, temperature, and temperature differences for five levels at each tower.

Wind Tower Correlation (ENBWTCOR)

This program compares the data from Towers 300 and 301. Using the output from the ENBWTCMP program, the program compares wind direction, wind speed, and temperature from a data-rich tower (300) and a relatively data-poor tower (301). Means and standard deviations for differences in wind direction, wind speed, and temperature are computed and categorized by 11 specified wind speeds. The difference is defined as the Tower 301 values minus the Tower 300 value. The format of the output table is similar to that of the ENBWTETI data (Figure 4). The tables are presented seasonally by wind directional sector and tower level. Also included is an annual and all-directional sector table.

ENBWTCOR

This section describes the creation of a new POR of winds and temperature data for micromet Tower 301. Due to the limited amount of data from Tower 301, the data from Tower 300 is used to create new "bogus" data for Tower 301.

Method of Analysis

Initially, data from the two towers were compared and concurrent observations extracted from each wind tower. A statistical regression analysis of these comparisons yielded regression coefficients which were utilized to create bogus data for the data-poor tower from the data-rich tower data.

The data were divided into day and night observations. The wind was broken down into U- and V-components for this analysis. The regression analysis compared the five levels of the U-component, V-component, and temperature of Tower 301 against the five levels of Tower 300. One component from one level of Tower 301 was compared against the three components of Tower 300 to find the best correlation (i.e., the U-component of level one (12 ft) of Tower 301 was compared against the five levels of the U-component, five levels of the V-component, and the five levels of the temperature component of Tower 300).

A comparison was made between the actual data of the two towers before the bogus data program was implemented. Besides being examined for annual day and night observations, the data were also analyzed for seasonal (spring, summer, autumn, winter) categories.

UNITED STATES AIR FORCE ENVIRONMENTAL TECHNICAL APPLICATIONS CENTER, SCOTT AFB, IL 62225 - ENBWTEI - 1.0 - PREPARED: 27 SEP 78									
VANDENBERG WINDS COMPARISON									
TOWER: 301									
CONSECUTIVE 15-MINUTE MEANS									
PERIOD OF RECORD: 750425-780521									
QUARTER: ANNUAL									
LEVEL: ALL FEET									
WIND DIRECTION: ALL									
SPEED IN MPH	DIRECTION DIFFERENCES (DEGREES)			SPEED DIFFERENCES (KNOTS)			TEMPERATURE DIFFERENCES (DEGREES F)		
	MEAN	STND DEV	NOF OBS	MEAN	STND DEV	NOF OBS	MEAN	STND DEV	NOF OBS
0-5	7.2	47.18	72454	0.1	2.45	32487	-0.1	1.95	33181
5-15	10.2	76.57	44707	4.7	12.13	44746	-0.2	1.54	47188
15-25	10.3	71.24	28742	7.5	11.93	27758	-0.1	1.29	22567
25-35	9.3	73.15	18071	8.4	8.81	35599	0.2	1.34	34297
35-45	8.8	71.85	11879	11.8	8.43	10886	0.2	2.15	11556
45-55	7.2	71.42	15779	11.3	12.33	21617	-0.1	1.89	21827
55-65	7.2	72.79	22075	7.2	11.94	22492	-0.1	1.66	21589
65-75	7.2	73.94	31765	6.1	12.79	21774	-0.1	1.39	20694
75-85	7.2	72.84	19772	6.2	11.84	16174	-0.1	1.35	15566
85-95	7.2	73.31	7587	7.4	12.11	7584	0.2	1.14	6994
95-100	7.2	73.25	741	8.4	8.81	8400	0.2	1.34	34297
*** NOF OBS: NUMBER OF OBSERVATION PAIRS ***									

Figure 3. Example of ENBWTEI Output.

UNITED STATES AIR FORCE ENVIRONMENTAL TECHNICAL APPLICATIONS CENTER, SCOTT AFB, IL 62225 - ENBWTCOR - 1.0 - PREPARED: 27 SEP 78									
VANDENBERG WINDS COMPARISON									
TOWER 300 VS TOWER 301									
PERIOD OF RECORD: 750425-780521									
QUARTER: ANNUAL									
LEVEL: ALL FEET									
WIND DIRECTION: ALL									
SPEED	DIRECTION DIFFERENCES			SPEED DIFFERENCES			TEMPERATURE DIFFERENCES		
	MEAN	STND DEV	NOF OBS	MEAN	STND DEV	NOF OBS	MEAN	STND DEV	NOF OBS
0-5	7.2	47.18	72454	0.1	2.45	32487	-0.1	1.95	33181
5-15	10.2	76.57	44707	4.7	12.13	44746	-0.2	1.54	47188
15-25	10.3	71.24	28742	7.5	11.93	27758	-0.1	1.29	22567
25-35	9.3	73.15	18071	8.4	8.81	35599	0.2	1.34	34297
35-45	8.8	71.85	11879	11.8	8.43	10886	0.2	2.15	11556
45-55	7.2	71.42	15779	11.3	12.33	21617	-0.1	1.89	21827
55-65	7.2	72.79	22075	7.2	11.94	22492	-0.1	1.66	21589
65-75	7.2	73.94	31765	6.1	12.79	21774	-0.1	1.39	20694
75-85	7.2	72.84	19772	6.2	11.84	16174	-0.1	1.35	15566
85-95	7.2	73.31	7587	7.4	12.11	7584	0.2	1.14	6994
95-100	7.2	73.25	741	8.4	8.81	8400	0.2	1.34	34297

Figure 4. Example of ENBWTCOR Output.

Regression Analysis

The statistical analysis used in this study was a step-wise multiple regression. Step-wise multiple regression is a statistical technique for analyzing a relationship between a dependent variable and a set of independent variables (best predictors) in the order of their importance. The method used to decide the order of the predictors is based upon the reduction of the sum of squares of the dependent variable. From this analysis, the regression coefficients from the best predictors were used in the creation of the bogus data. The Appendix to this report provides details of the regression analysis technique.

Creating Bogus Data

The bogus data were created by using the regression coefficients with the formulas

$$U(j) = UA(j) + \sum_{i=1}^5 [UB(j,i) U(i) + UC(j,i) V(i)] + UD(j) TD$$

$$V(j) = VA(j) + \sum_{i=1}^5 [VB(j,i) U(i) + VC(j,i) V(i)] + VD(j) TD$$

$$T(j) = TA(j) + \sum_{i=1}^5 [TB(j,i) U(i) + TC(j,i) V(i)] + \sum_{i=1}^5 [F(j,i) T(i)]$$

where U = U-component,

V = V-component,

T = temperature,

TD = temperature difference between level 5 and level 1,

j = the level being computed, in turn, from 1 through 5,

i = the level of the second tower for which the data are available, also for levels 1 through 5,

A, B, C, D and F are the regression coefficients.

The ENBWTRM program uses the above formulas to create a bogus POR. This program uses the regression coefficients and data values from the data-rich tower and computes new values for times when no observations are available for the data-poor tower. If just the data-poor tower had an observation or if both towers had observations at the same time, the data-poor observations were used unchanged. If just the data-rich tower had an observation, values were computed for the data-poor tower using the corresponding date-time group from the data-rich tower observation.

RESULTS

Comparison of Actual Data

The results of the analysis are shown in Table 4. The table contains the five levels of each component. The left column represents Tower 301 components and levels. The Tower 300 component that best correlates with the corresponding Tower 301 component and level are presented for day and night, each season, and annual summary.

Table 4. Correlation Coefficients for Towers 300 and 301.

TOWER 301 COMPONENT AND LEVEL	DEC-FEB 02-13Z COEFF	TOWER 300 COMPONENT AND LEVEL	DEC-FEB 14-01Z COEFF	TOWER 300 COMPONENT AND LEVEL	MAR-MAY 02-01Z COEFF	TOWER 300 COMPONENT AND LEVEL	MAR-MAY 14-01Z COEFF	TOWER 300 COMPONENT AND LEVEL	JUN-AUG 02-13Z COEFF	TOWER 300 COMPONENT AND LEVEL
U1	0.510	U1	0.670	U2	0.544	U3	0.611	U2	0.459	U1
U2	0.524	U1	0.682	U5	0.709	U1	0.798	U1	0.486	U2
U3	0.301	U5	0.469	U4	0.436	U1	0.715	U5	0.544	V2
U4	0.297	U5	0.368	U5	0.593	U4	0.648	U4	0.776	V5
U5	0.590	U1	0.751	U5	0.753	U2	0.821	U5	0.157	V2
V1	0.828	V3	0.759	V5	0.869	V1	0.869	V5	0.872	V5
V2	0.794	V5	0.736	V5	0.874	V1	0.885	V3	0.888	V5
V3	0.817	V5	0.750	V5	0.894	V1	0.897	V1	0.895	V5
V4	0.800	V2	0.727	V5	0.769	V5	0.783	V5	0.894	V3
V5	0.849	V5	0.800	V5	0.896	V1	0.895	V5	0.913	V5
T1	0.855	T1	0.924	T1	0.833	T1	0.765	T1	0.871	T1
T2	0.959	T3	0.933	T3	0.827	T3	0.614	T2	0.973	T2
T3	0.960	T3	0.944	T4	0.842	T3	0.606	T3	0.972	T3
T4	0.968	T5	0.945	T5	0.599	T5	0.483	T1	0.912	T3
T5	0.962	T5	0.939	T5	0.810	T5	0.553	T3	0.720	T5

TOWER 301 COMPONENT AND LEVEL	JUN-AUG 14-01Z COEFF	TOWER 300 COMPONENT AND LEVEL	SEP-NOV 02-13Z COEFF	TOWER 300 COMPONENT AND LEVEL	SEP-NOV 14-01Z COEFF	TOWER 300 COMPONENT AND LEVEL	ANNUAL 02-13Z COEFF	TOWER 300 COMPONENT AND LEVEL	ANNUAL 14-01Z COEFF	TOWER 300 COMPONENT AND LEVEL
U1	0.744	U1	0.436	V1	0.643	U2	0.453	U2	0.634	U5
U2	0.537	U1	0.434	V4	0.672	U1	0.495	U1	0.683	U5
U3	0.667	U2	0.384	V4	0.444	U4	0.370	U4	0.503	U5
U4	0.785	U4	0.513	V4	0.657	U5	0.544	U4	0.651	U5
U5	0.302	U3	0.592	V5	0.731	U5	0.562	U5	0.683	U5
V1	0.901	V5	0.779	V2	0.770	V5	0.802	V1	0.807	V3
V2	0.849	V3	0.813	V2	0.809	V5	0.818	V3	0.813	V5
V3	0.908	V5	0.783	V3	0.782	V5	0.821	V3	0.824	V5
V4	0.880	V5	0.831	V5	0.849	V5	0.781	V3	0.806	V5
V5	0.911	V6	0.856	V5	0.851	V5	0.859	V5	0.862	V5
T1	0.823	T1	0.877	T1	0.883	T1	0.859	T1	0.888	T1
T2	0.896	T4	0.937	T2	0.915	T3	0.946	T2	0.871	T3
T3	0.898	T4	0.945	T3	0.920	T3	0.950	T3	0.873	T3
T4	0.865	T4	0.924	T4	0.916	T4	0.849	T5	0.767	T4
T5	0.764	T4	0.927	T5	0.917	T5	0.923	T5	0.827	T4

this table shows that the V-component and temperature correlate better than the U-component. Some of the seasons correlated better than others, and the day correlations were higher than the night correlations. At certain levels there is not a one-to-one correspondence. In some of the U-component comparisons, the V-component from Tower 300 correlated better than the U-component at certain levels. The results of this analysis are also plotted (by component and by time of day) in Figures 5-10.

U-Component (0200-1300Z, Figure 5). The first and second levels correlate fairly well, while there is a large difference in levels 3, 4, and 5. The winter, spring, and fall pattern at levels 3 and 4 do not have very high correlations, while the summer correlations are highest at these levels. At level 5, all seasons correlate fairly well, except for summer.

U-Component (1400-0100Z, Figure 6). These graphs are little changed from the night graphs (Figure 5), but exhibit an overall higher correlation. The summer pattern still has the best correlation, and the winter the worst, except for the first two levels.

V-Component (0200-1300Z, Figure 7, and 1400-0100Z, Figure 8). The pattern of the V-component curves varies little between these two figures. Overall, the summer V-component exhibits the highest correlation.

Temperature (0200-1300Z, Figure 9, and 1400-0100Z, Figure 10). The spring temperature curves show the only significant variation. The best temperature correlations in the spring are at night.

Comparison of Bogus Data

Correlation Analysis. After creating the bogus data, correlation analyses were run on the bogus and actual tower data. The results of these analyses are in Table 5. The first two columns are the correlation coefficients for the actual Towers 300 and 301 data before creating the bogus data. The next two columns are the comparisons of the actual Tower 301 data versus the bogus 301 data created by forcing the actual Tower 301 data through the statistical analyses.

There is only a slight difference between the correlations of the actual Towers 301 and 300 data and the Tower 301 actual (before) and bogus (after) data. The bogus data have a slightly higher correlation, especially in the lower levels of the U-component in the night observations. The day observations are also a little higher. The largest difference is in the night U-component.

Examples of Bogus Data. Figures 11-14 are examples of the bogus data. The bogus observations have no gust, integration period (IP), or reliability number (RL).

Figure 11. The bogus data are in the 1100Z and 1130Z observations. This is a night summer situation with light to moderate winds. The winds and the surface temperatures correspond, but there is a variation in the temperature differences at upper levels.

Figure 12. This is a night spring situation, and in the bogus data there is approximately a 10-kt disparity between the actual wind and bogus winds.

Figure 13. This is a day summer situation and there is a disparity in the wind direction at all levels in the 1730Z bogus observation. But at 2030Z, the bogus observation is not much different from the 2000Z actual observation.

Figure 14. In this day winter situation, there is a good correspondence between the actual and bogus observations in both wind and temperature.

CONCLUSION

Actual Data Comparison

The rugged terrain at Towers 300 and 301 is a major factor in the low correlation of the U-Component for the towers. A contributing factor is the prevailing northerly wind component at the two towers.

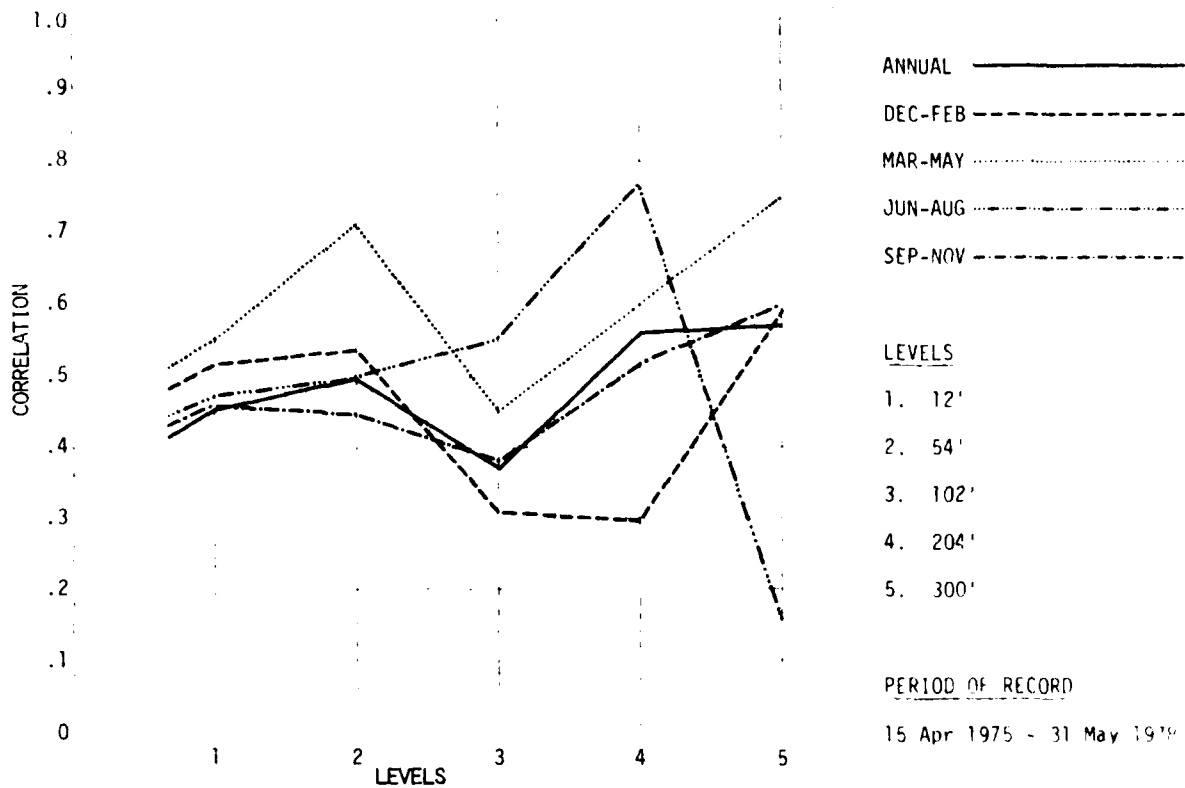


Figure 5. Correlation of U-Component (02-132) at Levels 1-5.

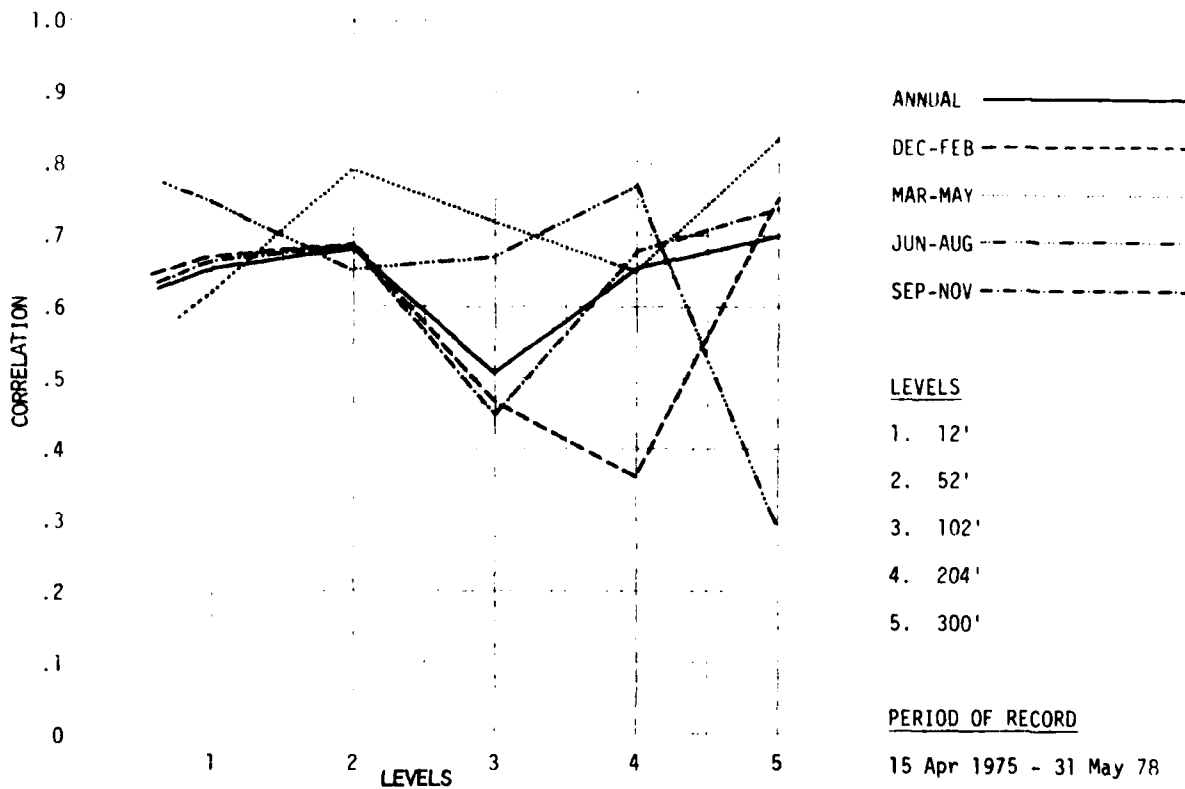


Figure 6. Correlation of U-Component (14-012) at Levels 1-5.

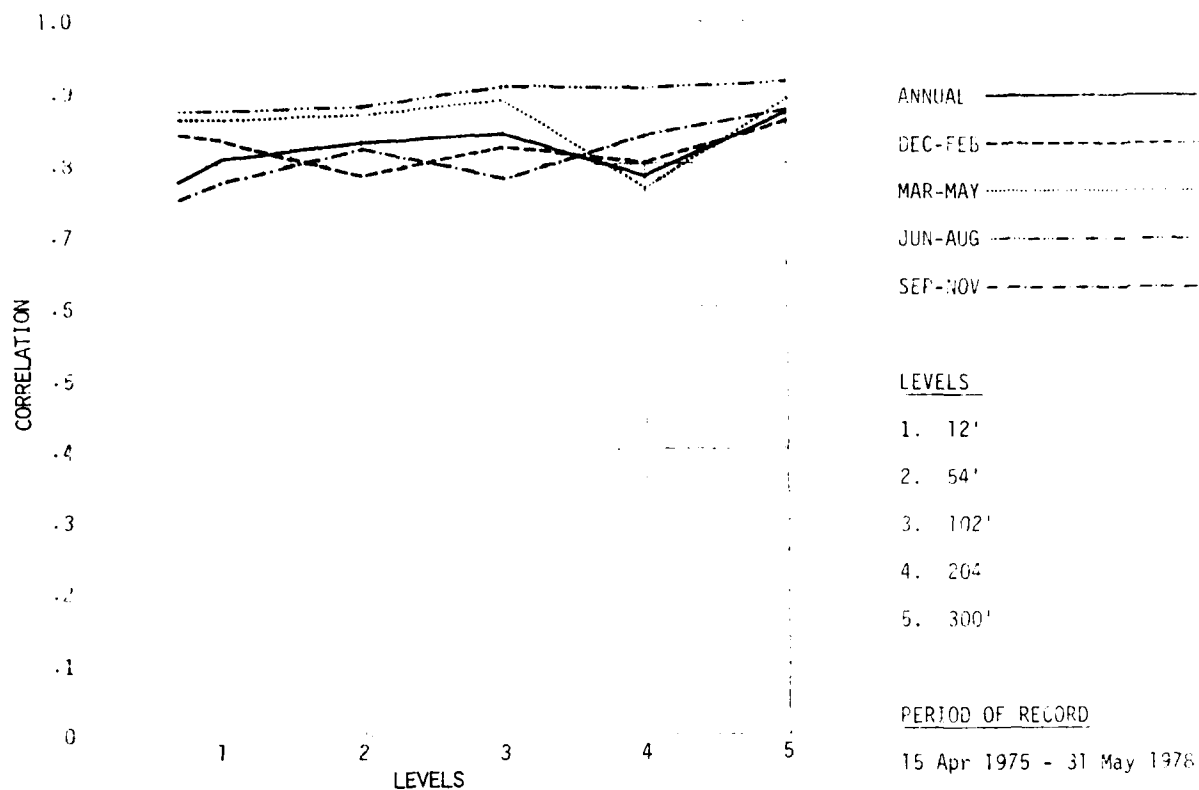


Figure 7. Correlation of V-Component (02-13Z) at Levels 1-5.

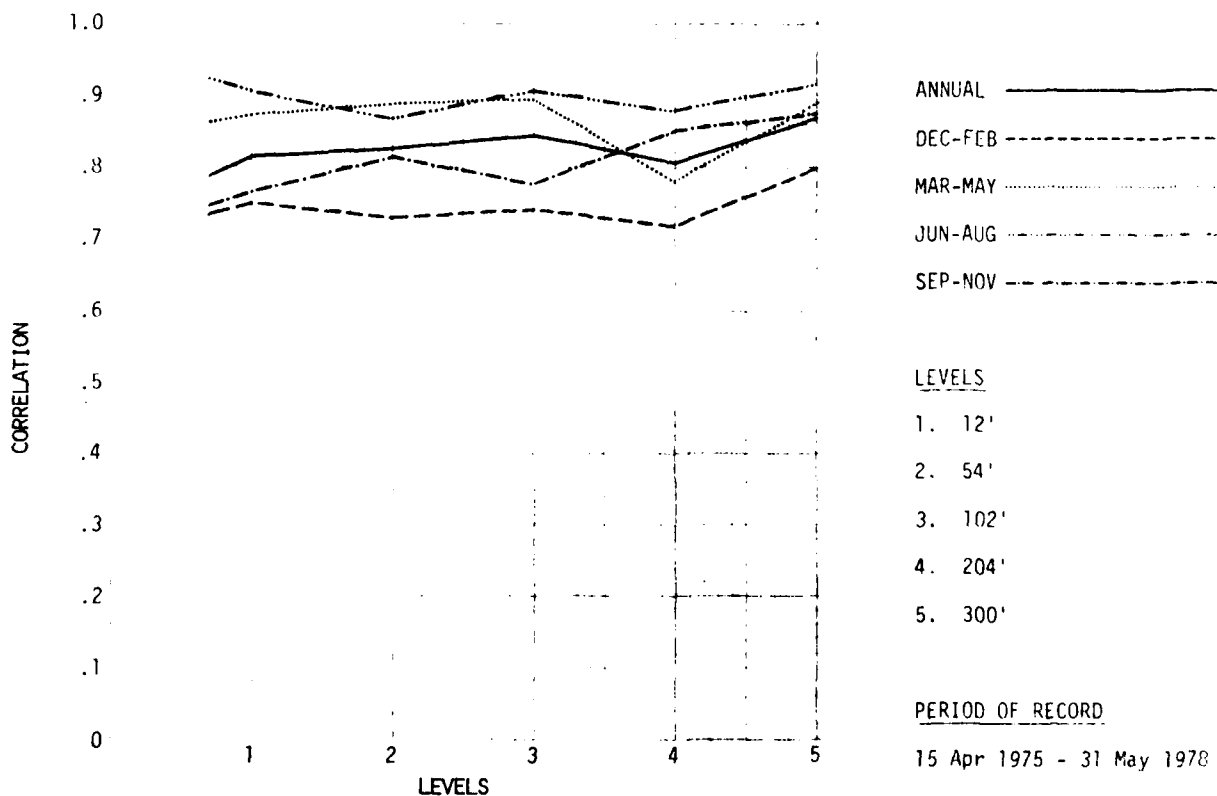


Figure 8. Correlation of V-Component (14-01Z) at Levels 1-5.

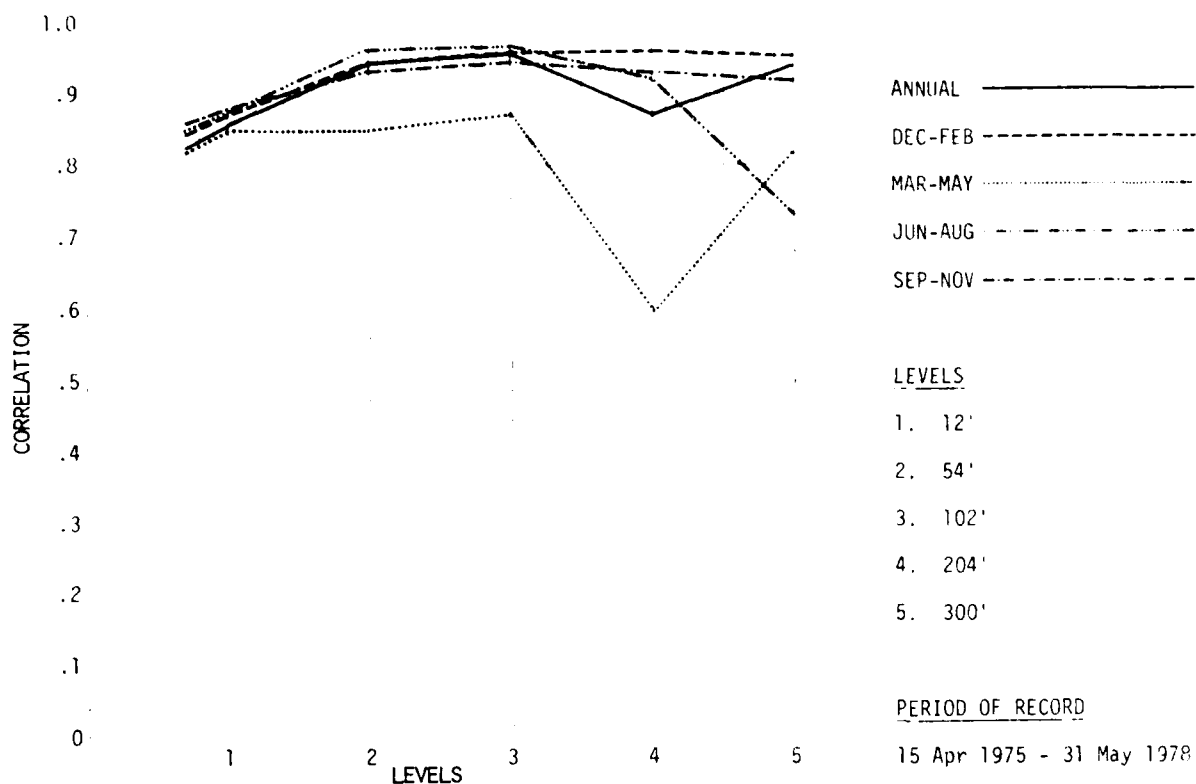


Figure 9. Correlation of Temperature (02-13Z) at Levels 1-5.

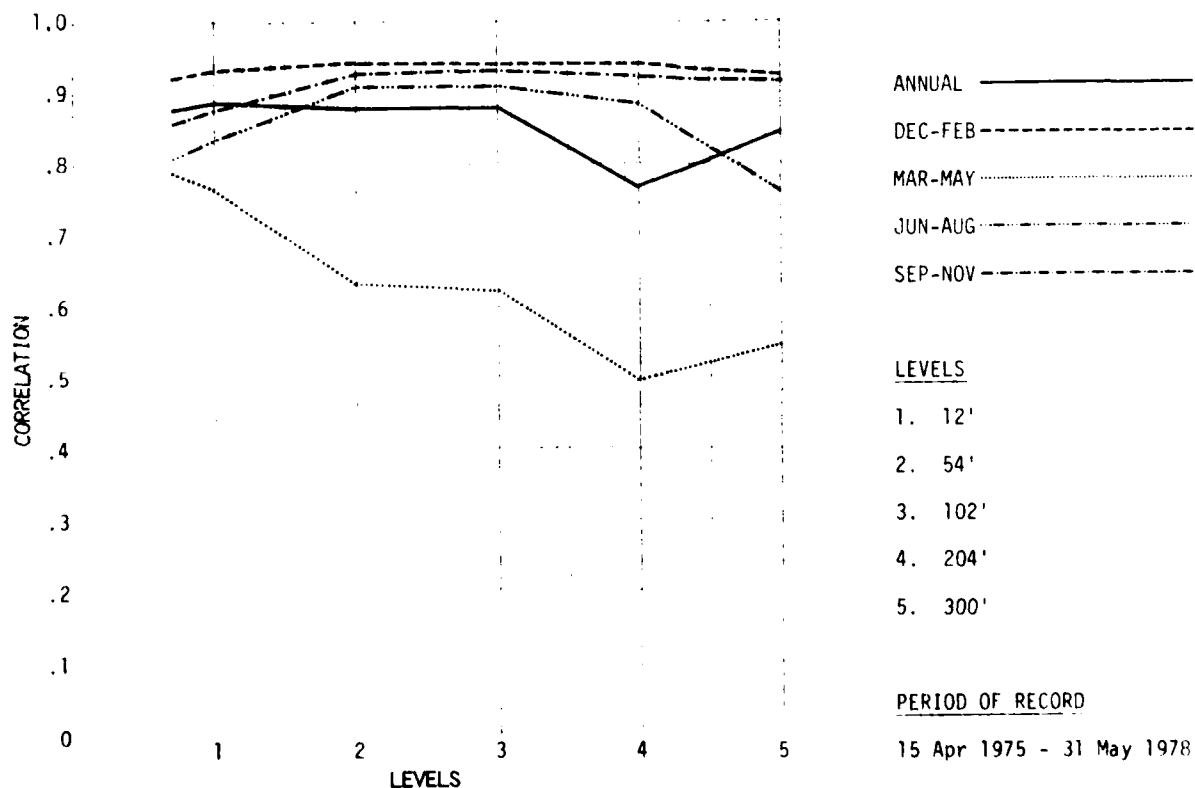


Figure 10. Correlation of Temperature (14-01Z) at Levels 1-5.

20

Figure 14. Example of Winter Day Bogus Data.

Table 5. Comparisons of Correlation Coefficients for Towers 300 and 301.

Component	Level	Before Bogus 301(A)/300(A)		After Bogus 301(A)/301(B)	
		02-13Z	14-01Z	02-13Z	14-01Z
U	1	0.413	0.634	0.518	0.641
U	2	0.445	0.683	0.511	0.687
U	3	0.370	0.503	0.560	0.619
U	4	0.544	0.651	0.560	0.650
U	5	0.562	0.683	0.513	0.689
V	1	0.802	0.807	0.860	0.858
V	2	0.818	0.813	0.860	0.858
V	3	0.821	0.824	0.862	0.858
V	4	0.781	0.806	0.829	0.860
V	5	0.859	0.862	0.868	0.862
T	1	0.859	0.888	0.925	0.885
T	2	0.946	0.871	0.947	0.866
T	3	0.950	0.873	0.950	0.871
T	4	0.849	0.767	0.933	0.871
T	5	0.923	0.837	0.925	0.854

A = Actual Data
B = Bogus Data

CONCLUSION

Actual Data Comparison

The rugged terrain at Towers 300 and 301 is a major factor in the low correlation of the U-Component for the towers. A contributing factor is the prevailing northerly wind component at the two towers.

For each component there is variance in the level comparisons. Again, the terrain probably causes most of variances. The best correlations between the two towers occur in the summer for all three components.

Bogus Data Comparisons

The regression equations used did not significantly improve the correlation coefficients for bogus Tower 301(A)/301(B) over the coefficients between Towers 300 and 301. The examples in Table 5 show that for some levels the bogus values correspond with the actual values. No increase in accuracy would be achieved using the bogus procedure to expand the POR of Tower 301. The actual Tower 300 data would produce comparable results.

REFERENCES

- Cunningham, T.J., 1977: Extreme Winds and Their Vertical Profile at SLC-6 Launch Pad, Vandenberg AFB CA, USAFETAC Report 8234, 15 pp, (available from NTIS AD-A040094)
- DeMarrais, G.A., G.C. Holzworth and C.R. Holser, 1965: Meteorological Summaries Pertinent to Atmospheric Transport and Dispersion Over Southern California, U.S. Dept. of Commerce, Weather Bureau Tech Paper No 54, 86 pp.
- Hinds, W.T. and P.W. Nickola, 1968: The Mountain Iron Diffusion Program: Phase I, South Vandenberg: Volume II, AEC. Research and Development Report, 133 pp.
- International Business Machines, 1970: System 360 Scientific Subroutine Package, Version III, 40-43.

Appendix A REGRESSION TECHNIQUE

This appendix presents the mathematical equations that are used by program ENBWTRM to select the independent variables and obtain their regression coefficients. The procedure, which comes from the IBM System 360 Scientific Subroutine Package, Version III, starts with the sums of cross-products of deviations matrix. The derivation of this matrix is not covered here; for information on its derivation, refer to other sources on regression analysis.

In each step of the regression

$$i = 1, 2, \dots, q$$

where q = number of independent variables

The first step in selecting the independent variable entering the regression is to compute the amount of reduction of sum of squares for each variable by

$$C_j = \frac{a_{jy}^2}{a_{jj}} \quad (A-1)$$

where

C_j = reduction of sum of squares,

a_{jj} = an element in the sum of cross-products of deviations matrix which will be modified in successive steps,

$j = 1, 2, \dots, q$ are independent variables ($j \neq$ variables deleted and variables entered before the i th step),

y = dependent variable.

The second step is to find the maximum (over j) of C .

Set $S_i = C_j$ to indicate the sum of squares that will be reduced in the i th step. The proportion of S_i to the total is obtained by

$$P = \frac{S_i}{D} \quad (A-2)$$

where $D = \sum_{j=1}^n (y_j - \bar{y})^2$

n = number of observations.

The cumulative sum of squares reduced is obtained by

$$S_{cum} = S_{cum} + S_i \quad (A-3)$$

and the cumulative proportion reduced by

$$P_{cum} = P_{cum} + P \quad (A-4)$$

The multiple correlation coefficient is computed by

$$R = (P_{cum})^{1/2} \quad (A-5)$$

and adjusted for degrees of freedom by

$$R_c = [1 - (1 - R^2) (n-1)/(n-k)]^{1/2}$$

where k = independent variables in the regression.

The F-value for analysis of variance is given by

$$F = \frac{S_{cum}/k}{(D-S_{cum})/(n-k-1)}$$

The standard error of the estimated y is obtained by the use of the formula

$$s_{y.12\dots i} = \left(\frac{D-S_{cum}}{n-k-1} \right)^{1/2} \quad (A-10)$$

and adjusted by

$$s_c = s \left[(n-1)/(n-k) \right]^{1/2}$$

Then, the following is computed

$$a_{jj} = a_{jj} + \frac{a_{ji}^2}{a_{ii}} \quad (A-11)$$

where i = variable entered in the i th step,

$j = v_1, v_2, \dots, v_{i-1}$ are the variables entered in the regression before the i th step, and

$$g_{ik} = \frac{a_{ik}}{a_{ii}} \quad (A-12)$$

where $k = 1, 2, \dots, m$ are variables including y ($k \neq$ variables deleted and the variables entered in the i th step).

Regression coefficients are computed by:

$$\begin{aligned} b_i &= g_{iy} \\ b_{i-1} &= g_{(i-1)y} - b_i g_{(i-1)i} \\ b_{i-2} &= g_{(i-2)y} - b_i g_{(i-2)i} - b_{i-1} g_{(i-2)(i-1)} \\ &\text{etc.,} \end{aligned} \quad (A-13)$$

and the value of the intercept is

$$b_0 = \bar{y} - \sum_{j=1}^k b_j \bar{x}_j \quad (A-14)$$

where k = number of independent variables in the regression.

Standard error of regression coefficients are given by

$$s_{bj} = (a_{jj} s_{y.12\dots i})^{1/2} \quad (A-15)$$

where $j = v_1, v_2, \dots, v_i$ are variables in the regression, and t-values as

$$t_j = \frac{b_j}{s_{bj}} \quad (A-16)$$

Perform the reduction to eliminate the variable entered in the i th step,

$$a_{jk} = a_{jk} - a_{ji} g_{ik} \quad (A-17)$$

where i = variable entered in the i th step,

$j = 1, 2, \dots, m$ ($j \neq$ variables deleted or variables in the regression)

$k = 1, 2, \dots, m$ ($k \neq$ variables deleted and the variable entered in the i th step)

$$a_{ji} = \frac{a_{ji}}{a_{ii}} \quad (j \neq i)$$

$$a_{ii} = \frac{1}{a_{ii}} \quad (j = i)$$

DATE
FILMED
- 8