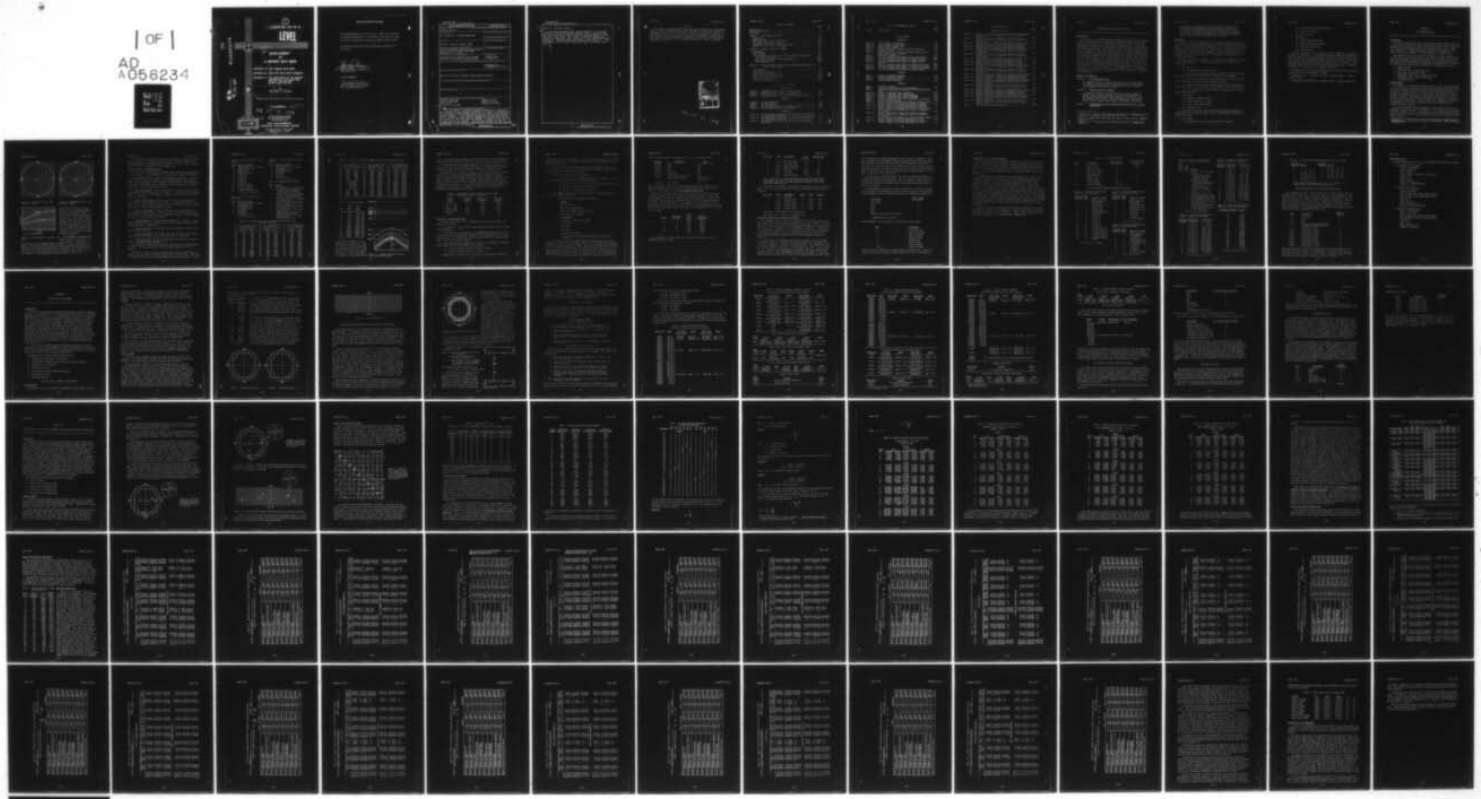
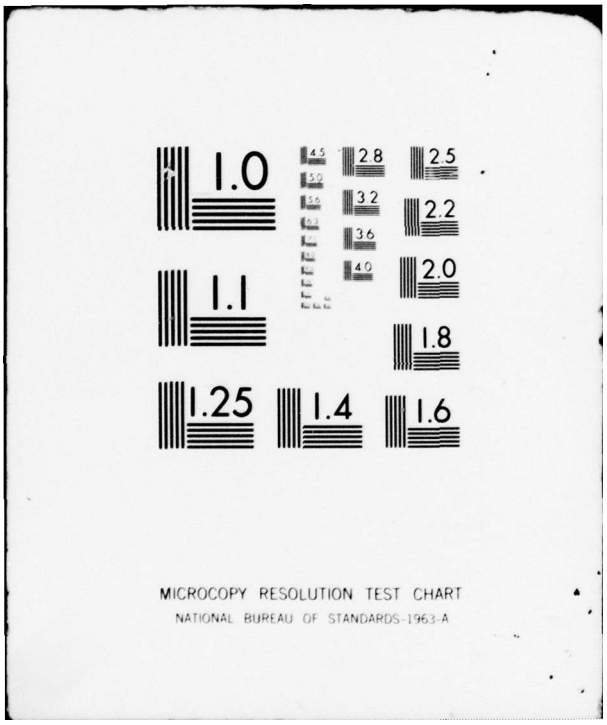
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DEVELOPMENT OF A GRIDDED DATA BASE. APPENDIX A. THE 3DNEPH DATA--ETC(U)
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DEVELOPMENT OF A GRIDDED DATA BASE

APPENDIX A - THE 3DNEPH DATA BASE

APPENDIX B - ANALYSIS DATA BASE SUMMARY

APPENDIX C - THE USEFULNESS OF THE GRIDDED CONVENTIONAL DATA BASE FOR CLIMATIC APPLICATION



(10) by
Capt Robert G. Feddes

(9) Technical note

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With the advent of numerical analysis adapted to a large computer system, global automated analysis of a variety of meteorological parameters became operational at the Air Force Global Weather Central (AFGWC). At the USAF Environmental Technical Applications Center (USAFETAC), these gridded analyses are maintained as one of the historical data sets used by USAFETAC to support a wide variety of data application requests. The gridded analyses now used at USAFETAC are in two distinct forms and they include a global analysis

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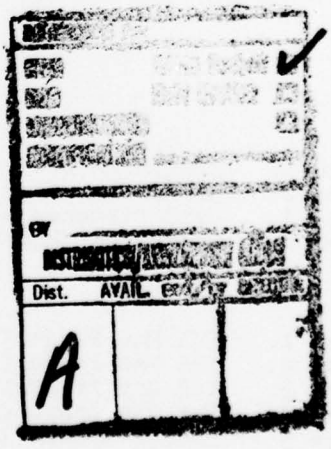
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of conventional parameters and a global analysis of the cloud scene at a variety of standard analysis times. This Technical Note describes the USAFETAC efforts in the development of these historical data bases. This report contains an explanatory appendix for each data base, Appendix A - 'The 3DNEPH Data Base,' Appendix B - 'Analysis Data Base Summary,' and Appendix C - 'The Usefulness of the Gridded Conventional Data for Climatic Application.'

Preface

Publication of this USAFETAC Technical Note had been delayed for various reasons such as constantly changing formats of the data bases described herein. However, requests for this information have prompted USAFETAC to publish this document. The information is current as of the original publication date except for Appendix A on the 3DNEPH Data Base; it has been revised so that the information is current as of March 1978. Any further information on the gridded data base, including updates to this information, will be published by USAFETAC at a later date as an entirely new publication. Send any questions or comments regarding this report to USAFETAC, Scott AFB, IL 62225.



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TABLE OF CONTENTS

	Page
Introduction	1
Appendix Descriptions	1
Application	1
APPENDIX A — THE 3DNEPH DATA BASE	A-1
Introduction	A-1
3DNEPH Overview	A-1
Input Data Base - Content and Format	A-3
Input Tape - Content and Format	A-6
Reformatted Time Series - Content and Format	A-9
Summarized File - Content and Format	A-11
APPENDIX B — ANALYSIS DATA BASE SUMMARY	B-1
Introduction	B-1
Time Coverage	B-1
Areal Coverage	B-2
Interpolation Technique Used for Map Projection Consistency	B-4
The Initial Time Series	B-11
File Formats and Tape Storage Requirements	B-11
Data Quality Control	B-12
The Summarized File	B-13
APPENDIX C — THE USEFULNESS OF THE GRIDDED CONVENTIONAL DATA BASE FOR CLIMATIC APPLICATION	C-1
Introduction	C-1
Input Data Base	C-1
Scope of the Feasibility Study	C-4
Grouped Versus Ungrouped	C-5
Station Data Versus Analysis Data	C-13
Scope of the Station Comparisons	C-15
Data Form Comparisons	C-15
Limitation of the Comparisons	C-41

LIST OF ILLUSTRATIONS

APPENDIX A

Figure 1.	3DNEPHNHA Projection Map of Numbered Boxes	A-2
Figure 2.	3DNEPHSHA Projection Map of Numbered Boxes	A-2
Figure 3.	Grid Distance as a Function of Latitude	A-2
Figure 4.	Schematic Showing Overlap between AGL and MSL Layers	A-5

APPENDIX B

Figure 1.	NHA Map Projection	B-3
Figure 2.	SHA Map Projection	B-3
Figure 3.	TWA Map Projection	B-4
Figure 4.	The Overlapping Portion of the NHA and TWA	B-5
Figure 5.	Double-Linear Interpolation Schematic	B-5

APPENDIX C

Figure 1a.	The Relationship Between Grid Coordinates and Conventional Coordinates for the NHA	C-2
Figure 1b.	The Relationship Between Grid Coordinates and Conventional Coordinates for the SHA	C-3
Figure 1c.	The Relationship Between the TWA Grid and Conventional Components	C-3

LIST OF ILLUSTRATIONS (Cont'd)

Page

Figure 2. AFGWC-box #44 . . . . . C-4

LIST OF TABLES

APPENDIX A

Table 1a. Code for Type of Low Clouds A-4
Table 1b. Code for Type of Middle Clouds. A-4
Table 1c. Code for Type of High Clouds. A-4
Table 1d. 3DNEPH Present Weather. A-4
Table 1e. Minimum Cloud Base - Maximum Cloud Top Code Table A-4
Table 2. Designated Layers A-5
Table 3. Relationship of Low, Middle, and High Clouds to the 15 Layers when Terrain is Present. A-6
Table 4. Histogram Information A-12
Table 5a. Code and Histogram Entry Number for Low Cloud Type. . . . A-12
Table 5b. Code and Histogram Entry Number for Middle Cloud Type . . A-12
Table 5c. Code and Histogram Entry Number for High Cloud Type . . . A-12
Table 5d. Code and Histogram Entry Number for 3DNEPH Present Weather A-13
Table 5e. Code and Histogram Entry Number for Maximum Cloud Bases . A-13
Table 5f. Code and Histogram Entry Number for Minimum Cloud Bases . A-13
Table 5g. Code and Histogram Entry Number for Total Cloud Coverage. A-13
Table 5h. Code and Histogram Entry Number for Layered Amounts . . . A-14

APPENDIX B

Table 1. Latitude of TWA-Numbered Rows B-3
Table 2. Northern Hemisphere Analysis. B-7
Table 3. Southern Hemisphere Analysis. B-9
Table 4. Tropical Weather Analysis B-10

APPENDIX C

Table 1. Data Used in Study. C-5
Table 2. Intervals and Mid-points of the Parameters. C-6
Table 3. Six-Level Temperature Distribution of the Northern Hemisphere C-7
Table 4-1. Grouped vs Ungrouped Data, D-VALUE. C-9
Table 4-2. Grouped vs Ungrouped Data, TEMPERATURE. C-10
Table 4-3. Grouped vs Ungrouped Data, WIND U-COMPONENT C-11
Table 4-4. Grouped vs Ungrouped Data, WIND V-COMPONENT C-12
Table 5. List of Stations and I,J, Grid Points Used in the Study . C-14
Table 6. Interval Mid-point Values C-15
Table 7-1. Values of Specified Parameters at Various Pressure Levels Beirut, Lebanon, D-Value and Temperature for January. . . C-16
Table 7-2. Maximum Differences in Means and Standard Deviations, Beirut, Lebanon, D-Value and Temperature for January. . . C-17
Table 7-3. Values of Specified Parameters at Various Pressure Levels Beirut, Lebanon, Wind U-Component and Wind V-Component for January C-18
Table 7-4. Maximum Differences in Means and Standard Deviations Beirut, Lebanon, Wind U-Component and Wind V-Component for January C-19
Table 7-5. Values of Specified Parameters at Various Pressure Levels Beirut, Lebanon, D-Value and Temperature for July C-20
Table 7-6. Maximum Differences in Means and Standard Deviations Beirut, Lebanon, D-Value and Temperature for July C-21

LIST OF TABLES (Cont'd)

APPENDIX C (Cont'd)

		Page
Table 7-7.	Values of Specified Parameters at Various Pressure Levels Beirut, Lebanon, Wind U-Component and Wind V-Component for July.	C-22
Table 7-8.	Maximum Differences in Means and Standard Deviations Beirut, Lebanon, Wind U-Component and Wind V-Component for July.	C-23
Table 7-9.	Values of Specified Parameters at Various Pressure Levels Albrook AFB, CZ, D-Value and Temperature for January.	C-24
Table 7-10.	Maximum Differences in Means and Standard Deviations, Albrook AFB, CZ, D-Value and Temperature for January.	C-25
Table 7-11.	Values of Specified Parameters at Various Pressure Levels Albrook AFB, CZ, Wind U-Component and Wind V-Component for January	C-26
Table 7-12.	Maximum Differences in Means and Standard Deviations, Albrook AFB, CZ, Wind U-Component and Wind V-Component for January	C-27
Table 7-13.	Values of Specified Parameters at Various Pressure Levels Albrook AFB, CZ, D-Value and Temperature for July	C-28
Table 7-14.	Maximum Differences in Means and Standard Deviations, Albrook AFB, CZ, D-Value and Temperature for July	C-29
Table 7-15.	Values of Specified Parameters at Various Pressure Levels Albrook AFB, CZ, Wind U-Component and Wind V-Component for July.	C-30
Table 7-16.	Maximum Differences in Means and Standard Deviations, Albrook AFB, CZ, Wind U-Component and Wind V-Component for July.	C-31
Table 7-17.	Values of Specified Parameters at Various Pressure Levels Hallett, Antarctica, D-Value and Temperature for January.	C-32
Table 7-18.	Maximum Differences in Means and Standard Deviations, Hallett, Antarctica, D-Value and Temperature for January.	C-33
Table 7-19.	Values of Specified Parameters at Various Pressure Levels Hallett, Antarctica, Wind U-Component and Wind V-Component for January.	C-34
Table 7-20.	Maximum Differences in Means and Standard Deviations, Hallett, Antarctica, Wind U-Component and Wind V-Component for January.	C-35
Table 7-21.	Values of Specified Parameters at Various Pressure Levels Hallett, Antarctica, D-Value and Temperature for July	C-36
Table 7-22.	Maximum Differences in Means and Standard Deviations, Hallett, Antarctica, D-Value and Temperature for July	C-37
Table 7-23.	Values of Specified Parameters at Various Pressure Levels Hallett, Antarctica, Wind U-Component and Wind V-Component for July	C-38
Table 7-24.	Maximum Differences in Means and Standard Deviations, Hallett, Antarctica, Wind U-Component and Wind V-Component for July	C-39
Table 8.	Station and Grid-Point Comparisons.	C-41

DEVELOPMENT OF A GRIDDED DATA BASE

Introduction

With the advent of numerical analysis adapted to a large computer system, global automated analysis of a variety of meteorological parameters became operational at the Air Force Global Weather Central (AFGWC). At the USAF Environmental Technical Applications Center (USAFETAC), these gridded analyses are maintained as one of the historical data sets used by USAFETAC to support a wide variety of data application requests. The gridded analyses now used at USAFETAC are in two distinct forms and they include a global analysis of conventional parameters and a global analysis of the cloud scene at a variety of standard analysis times. This Technical Note describes the USAFETAC efforts in the development of these historical data bases. This report contains an explanatory appendix for each data base (A and B) and another appendix describing a study conducted on the conventional analysis data base (C). Following is (1) a brief description of each Appendix, and (2) a discussion concerning the applications of various forms of these data bases by themselves and in combination.

Appendix Descriptions

Appendix A - "The 3DNEPH Data Base"

> This appendix contains a complete description of the 3DNEPH Analysis (3DNEPH) contents and the computer tape formats of the different forms within the data base. The derivation of the parameters in the 3DNEPH are described by Coburn[1].

Appendix B - "Analysis Data Base Summary"

> This appendix contains a complete description of the contents of the global AFGWC analyses which include the Northern Hemisphere Analysis (NHA), Southern Hemisphere Analysis (SHA), and the Tropical Weather Analysis (TWA). The development of the NHA and SHA are described by Moreno[2], and the TWA by Shumbera[3]. The appendix further details computer tape formats of the analysis data base.

Appendix C - "The Usefulness of the Gridded Conventional Data for Climatic Application"

---

[1] Coburn, A. R.: "Improved Three Dimensional Nephanalysis," AFGWCTM 71-2, USAF Global Weather Central, Offutt AFB, NE, 1971, 72 p.

[2] Moreno, D.: "AFGWC Macro-scale Upper Air Analysis Model (Revised," AFGWCTM 73-1, 1973, 25 p.

[3] Shumbera, A. L.: "Tropical Wind and Temperature Analysis," AFGWCTM 69-5, 1969, 14 p.

This appendix describes the results of a study to determine the usefulness of the temperature, D-values (height), and U- and V-wind components from the NHA, SHA, and TWA, and a study of the dew points in the NHA. The results are a comparison of the analyses data with conventional station data. In addition, the method used to merge the three data sources is discussed and the method used to quality control the parameter is described.

Application

The 3DNEPH described in Appendix A and the analysis data base described in Appendix B are being reformatted to allow rapid access that will minimize the computer time required for their processing. Each of the data bases has many useful applications both by itself or in combination. Below is a list of the applications of each data base by themselves. A subsequent paragraph will evaluate the use of the two data bases in combination for application to environmental simulation.

The 3DNEPH data base is available in a time-series form and also in a summarized form (Appendix A). Several major applications for each form are listed below:

a. Time Series:

(1) Cloud-Free Line-of-Sight (CFLOS).

(2) Atmospheric transmission studies that require cloud information, such as attenuation, and a wide variety of electro-optics problems.

(3) Studies in correlation of the visibility of more than one earth point at the same time from a location above the ground.

(4) Decision logic to select optimum cost-effective strategies including a spectrum of activities from basic research to real-time operations.

(5) As an integral part of the USAFETAC's Advanced Research Project Agency (ARPA) data base.

b. Summarized:

(1) Parameter frequency studies.

(2) Cloud climatology of a point.

(3) Global cloud-cover studies.

(4) ARPA data base.

The global grid-point data base of conventional parameters (Appendix B) has application in a variety of areas both in the summarized as well as the time-series format.

a. Time Series:

(1) Parameter profiling in the point-analysis program.

(2) Tailored route wind factor studies.

(3) Post-event analysis.

(4) ARPA data base.

b. Summarized:

(1) Global climatology update.

(2) Operational data validation.

(3) Grid-point climatology.

(4) ARPA data base.

The major application of the combination of the 3DNEPH and the gridded analysis is in simulation. The USAFETAC simulation model uses parameters from both the 3DNEPH and the gridded analyses to provide a profile of the liquid water content (LWC), and thermodynamic phase (TDP) of the LWC, and the resulting drop-size distribution (DSD) of the various forms of LWC present. This simulation should have an ever-widening variety of application. A complete description is contained in the following references:

USAFETAC TN 74-4, "A Synoptic-Scale Model for Simulating Condensed Atmospheric Moisture," by Capt Robert G. Feddes.

USAFETAC TN 74-1: "Atmospheric Moisture Parameterization," - Captain Robert D. Smith.

USAFETAC Project 6988 Report by Captain Robert G. Feddes (unpublished).

Appendix A

THE 3DNEPH DATA BASE

Introduction

The USAF Environmental Technical Applications Center (USAFETAC) has been receiving and storing the Air Force Global Weather Central (AFGWC) operational real-time three-dimensional analysis of clouds referred to as the 3DNEPH[1] since January 1971. USAFETAC was tasked to maintain the 3DNEPH as a new source of data and to develop it for applications to customer needs.

This appendix describes the efforts at USAFETAC to take the 3DNEPH file that has been accumulated and produce a data base that lends itself to rapid access and automated processing and retrieval. All of the major computer processing involving the 3DNEPH is accomplished at USAFETAC OL-A in Asheville, NC. This appendix describes and discusses the following major subjects:

- 3DNEPH overview
- Input data base - content and format
- Input tape - content and format
- Reformatted time series - content and format
- A summarized file - content and format
- Tape specifications

3DNEPH Overview

The 3DNEPH is a global analysis that is unique in its concept and design. It is the only type of analysis that uses all conventional and satellite data and produces operationally useful global three-dimensional cloud-cover information as a single product on a routine basis. The detailed information thus made available provides a data base that has applicability to a wide variety of problems. The 3DNEPH is formulated into two parts, the Northern and the Southern Hemispheres. These two parts will hereafter be referred to as 3DNEPHNHA for the Northern Hemisphere portion and 3DNEPHSHA for the Southern Hemisphere portion.

The current analysis uses the projection of the Northern and Southern Hemispheric analyses described in Appendix B. Their projections and coverage are shown in Figures 1 and 2. The projection is a 1:20,000,000 polar stereographic projection with 80° west as the prime meridian in the Northern Hemis-

[1] Coburn, A. R.: "Improved Three Dimensional Nephanalysis," AFGWC Technical Memorandum 71-2, United States Air Force Global Weather Central, Offutt AFB, NE, 1971, 72 p.

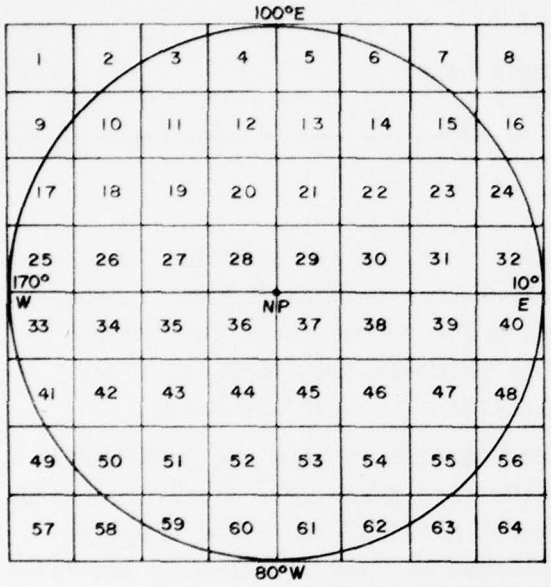


Figure 1. 3DNEPHNHA Projection Map of Numbered Boxes.

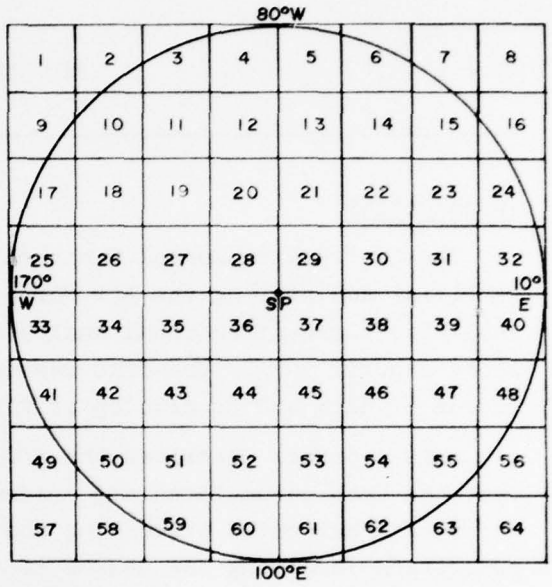


Figure 2. 3DNEPHSHA Projection Map of Numbered Boxes.

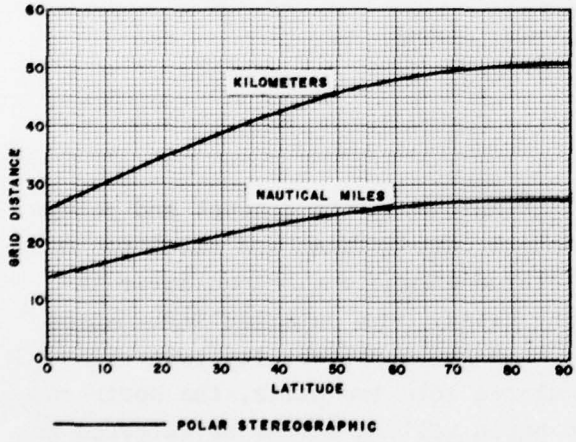


Figure 3. Grid Distance as a Function of Latitude.

phere and 100° east as the prime meridian in the Southern Hemisphere. Each of the hemispheric disks is divided into 64 boxes, numbered from upper left to lower right. Within each box there are 4096 grid points arranged in 64 rows and 64 columns. The horizontal resolution is a function of latitude and is approximately 25 nm at 45° of latitude. Grid distance, as a function of latitude, is shown in Figure 3.

The 3DNEPHNHA is analyzed every three hours at 00, 03, 06, 09, 12, 15, 18, and 21Z. The period of record (POR) for the 3DNEPHNHA begins in January of 1971. At the outset, the analysis covered 32 boxes with additional boxes being added in 1972 and 1973. Currently, even though there are 64 boxes, a maximum of 60 boxes are analyzed (less boxes 1, 8, 57, and 64 which are off the disk). Thus, a data availability catalogue is being maintained as the data base is being accumulated.

The 3DNEPHSHA is operational at AFGWC and USAFETAC is saving this analysis as of 4 May 1974. The 3DNEPHSHA will be placed in the same format as the 3DNEPHNHA described in the previous and subsequent sections. The box numbers will be 101-164 for 3DNEPHSHA in the USAFETAC files.

Input Data Base - Content and Format

This section will describe the 3DNEPHNHA data for a grid point and explain the tape formats of the 3DNEPHNHA as it is received at USAFETAC from AFGWC.

The 3DNEPHNHA contains a total of 22 parameters at each point. The first seven are cloud types (low, middle, high), weather, maximum tops, minimum bases, and total coverage (herein called point parameters). The remaining 15 are percent cloud amounts for 15 layers of variable thicknesses. A description of the first seven parameters follows:

a. Type of LOW Cloud. Stratus, stratocumulus, cumulus, cumulonimbus, and combinations of these types are used (15 types). A zero indicates the parameter is not present or its existence is unknown. Table 1a gives the code for type(s) of LOW cloud.

b. Type of MIDDLE Cloud. Nimbostratus, altocumulus, altostratus, and combinations of these types are used. There is a total of seven types. An entry of zero means the same as indicated for the LOW clouds. Table 1b gives the code to be used with the MIDDLE cloud types

c. Type of HIGH Cloud. Cirrus, cirrostratus, and cirrocumulus, and combinations of these are used. There is a total of seven HIGH cloud entries. A zero entry means the same as for the middle and low clouds. Table 1c gives the code to be used for the HIGH clouds.

d. Present Weather. The present weather parameter is coded 0-9. These numbers are the WMO present weather code, cade table 4677 divided by integer 10 with truncation. See Table 1d.

e. Maximum Cloud Tops. The maximum-cloud-top parameter is coded using WMO Table 1677, Table 1e.

f. Minimum Cloud Base. The minimum cloud base is coded using the same table as used for the maximum cloud tops (WMO Code 1677, Table 1e).

g. Total Cloud Cover. Percent of cloud cover at the point is coded directly to the nearest whole percent (0-100).

The remaining 15 parameters are vertical distribution of cloud amounts at the point. The bases and tops of the 15 designated layers are given in Table 2.

Referring to Table 2, the first six layers are terrain following (AGL) and the final nine layers are measured above mean sea level (MSL). When there is terrain, there will be an overlap between the AGL and MSL layers. To avoid

Table 1a. Code for Type(s) of Low Clouds.

Code	Type(s) of Cloud
0	Type unknown or not present
1	Stratocumulus (SC)
2	Stratus (ST)
3	Cumulus (CU)
4	Cumulonimbus (CB)
5	SC and ST
6	SC and CU
7	SC and CB
8	ST and CU
9	ST and CB
10	CU and CB
11	SC and ST and CU
12	SC and ST and CB
13	SC and CU and CB
14	ST and CU and CB
15	SC and ST and CU and CB

Table 1b. Code for Type(s) of Middle Clouds.

Code	Type(s) of Cloud
0	Type unknown or not present
1	Altocumulus (AC)
2	Altostratus (AS)
3	Nimbostratus (NS)
4	AC and AS
5	AC and NS
6	AS and NS
7	AC and AS and NS

Table 1c. Code for Type(s) of High Clouds.

Code	Type(s) of Cloud
0	Type unknown or not present
1	Cirrus (CI)
2	Cirrocumulus (CC)
3	Cirrostratus (CS)
4	CI and CC
5	CI and CS
6	CC and CS
7	CI and CC and CS

Table 1d. 3DNEPH Present Weather.

Code	Weather
0	No wea, haze, dust, sand, smoke
1	Mist, shal fog, lightning/no thun, precip in sight, T-storm, squalls, fun-cld
2	Precip, fog, ice fog, thunderstorm at station during past hr but not at time of obs
3	Duststorm, sandstorm - drifting or blowing snow
4	Fog or ice fog at time of obs
5	Drizzle (freezing or nonfreezing) at time of obs
6	Rain (freezing or nonfreezing) at time of obs
7	Solid precip not in showers at time of obs
8	Showery precip (rain and/or snow) at time of obs
9	Precip with current or recent thunderstorm

Table 1e. Minimum Cloud Base - Maximum Cloud Top Code Table. (WMO Code Table 1677)

Code	Min Base/Max Top		Code	Min Base/Max Top		Code	Min Base/Max Top	
	Meters	Feet		Meters	Feet		Meters	Feet
00	< 30	< 100	15	450	1500	30	900	3000
01	30	100	16	480	1600	31	930	3100
02	60	200	17	510	1700	32	960	3200
03	90	300	18	540	1800	33	990	3300
04	120	400	19	570	1900	34	1020	3400
05	150	500	20	600	2000	35	1050	3500
06	180	600	21	630	2100	36	1080	3600
07	210	700	22	660	2200	37	1110	3700
08	240	800	23	690	2300	38	1140	3800
09	270	900	24	720	2400	39	1170	3900
10	300	1000	25	750	2500	40	1200	4000
11	330	1100	26	780	2600	41	1230	4100
12	360	1200	27	810	2700	42	1260	4200
13	390	1300	28	840	2800	43	1290	4300
14	420	1400	29	870	2900	44	1320	4400

Table 1e. Minimum Cloud Base - Maximum Cloud Top Code Table (Cont'd).

Code	Min Base/Max Top		Code	Min Base/Max Top		Code	Min Base/Max Top	
	Meters	Feet		Meters	Feet		Meters	Feet
45	1350	4500	60	3000	10000	75	7500	25000
46	1380	4600	61	3300	11000	76	7800	26000
47	1410	4700	62	3600	12000	77	8100	27000
48	1440	4800	63	3900	13000	78	8400	28000
49	1470	4900	64	4200	14000	79	8700	29000
50	1500	5000	65	4500	15000	80	9000	30000
51	- not used -		66	4800	16000	81	10500	35000
52	- not used -		67	5100	17000	82	12000	40000
53	- not used -		68	5400	18000	83	13500	45000
54	- not used -		69	5700	19000	84	15000	50000
55	- not used -		70	6000	20000	85	16500	55000
56	1800	6000	71	6300	21000	86	18000	60000
57	2100	7000	72	6600	22000	87	19500	65000
58	2400	8000	73	6900	23000	88	21000	70000
59	2700	9000	74	7200	24000	89	> 21000	> 70000

Table 2. Designated Layers.

Layer	Base of Layer (ft)	Top of Layer (ft)	
1	Sfc	150	AGL
2	151	300	AGL
3	301	600	AGL
4	601	1000	AGL
5	1001	2000	AGL
6	2001	3500	AGL
7	3501	5000	MSL
8	5001	6500	MSL
9	6501	10000	MSL
10	10001	14000	MSL
11	14001	18000	MSL
12	18001	22000	MSL
13	22001	26000	MSL
14	26001	35000	MSL
15	35001	55000	MSL

duplication of coverage if the terrain height and the top of layer 6 (3500 ft) are added and they are greater than the top of an MSL layer, the MSL layer cloud amount is coded as a 127 for that layer. The example in Figure 4 would have

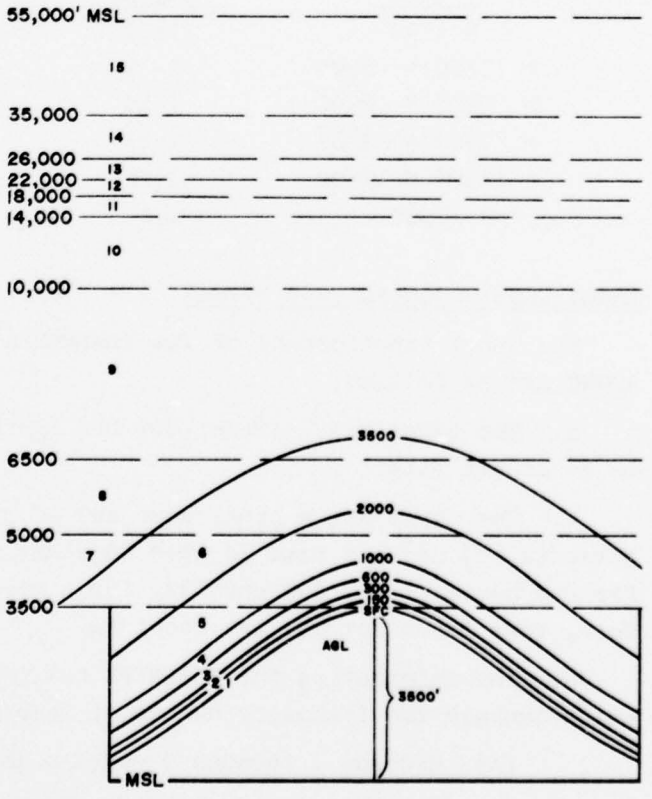


Figure 4. Schematic Showing Overlap between AGL and MSL Layers.

a 127 in the data entry for layers 7 and 8 since the sum of 3500 plus 3500 is greater than 6500; the base of layer 9 in this case would now become 7000 ft.

Cloud amount entries for the 15 layers is to the nearest 5% (0, 5, 10, ... 100). In the case of thin clouds in the layer, a 1 is added to the percent coverage for that layer so that 25% thin cloud would be encoded as 26.

The parameters for a point are related to the vertical layers by the definition of low, middle, and high clouds which are a function of terrain. Table 3 shows the relationship between low, middle, and high clouds as a function of terrain. In the example in Figure 4 with a terrain of 3500 feet, layers 1-9 are low clouds, 10-12 are middle clouds, and 13-15 are high clouds. An exception to this rule is, of course, convective low clouds (cumulus and cumulonimbus combinations). The tops of these convective clouds will be governed by the maximum cloud top entry.

Table 3. Relationship of Low, Middle, and High Clouds to the 15 Layers when Terrain is Present.

Terrain (ft)	Low Cloud Layers	Middle Cloud Layers	High Cloud Layers
≤ 1750	1- 8	9-12	13-15
> 1750 ≤ 5500	1- 9	10-12	13-15
> 5500 ≤ 9500	1-10	11-13	14-15
> 9500 ≤ 13500	1-11	12-13	14-15
> 13500 ≤ 17500	1-12	13-14	15
> 17500	1-13	14	15

Input Tape - Content and Format

The input tape formats of the 3DNEPHNHA as they arrive at USAFETAC from AFGWC are as follows:

a. The tapes are 7-track, 800 BPI (Bytes Per Inch) where one word is equal to 36 binary bits.

b. The tapes are a continuous set of 3DNEPHNHA information with all the boxes (1-64) for one time located together on the tape (synoptic file). Data for two hours, i.e., 00Z and 03Z, for a given date are put on a tape; therefore, four tapes per day are received.

c. The information for a 3DNEPH box (Figure 1) is contained in 10 records which contain the following number of 36-bit words:

(1) Records 1 through 9 contain 1696 36-bit words.

(2) Record 10 contains 1264 36-bit words.

d. Each record contains four 36-bit words of documentation followed by

1692 36-bit data words in records 1, 2, 4, 5, 6, 7, 8, and 9; 1672 36-bit data words and 20 zero words in record 3; and, 1176 36-bit data words and 84 zero words in record 10.

e. The four tapes per day are processed by the DATA SAVE program where the four tapes are consolidated to approximately two tapes per day of data and a data availability determination is made.

f. The resulting tape format is as follows:

(1) The information for a 3DNEPH box (Figure 1) is changed to 10 variable length records which are of the following lengths:

(a) Records 1, 2, 4, 5, 6, 7, 8, and 9 contain 1694 36-bit words

(b) Record 3 contains 1674 36-bit words

(c) Record 10 contains 1178 36-bit words

(2) Each record contains two 36-bit words of documentation which contain the following information:

- 36-bit word 1 is BCD code (6-bit bytes)

  MMSCNN

  MM is always 00

  SC is BCD configuration

  NN is the 3DNEPH box number in BCD

- 36-bit word 2 is binary

  YYMMDDHHBNRC

  YY is year - 1960 (13_8 is 1971)

  MM is month

  DD is day

  HH is hour

  BN is the box number

  RC is the record number for the group of 10 records for each box

g. The preprocessing and data availability determination also involve changing all records to fixed length. Each of the ten records are increased to a fixed length of 1698 36-bit words. This is done to make the data usable on an 8-bit byte-oriented system. The resulting record length is 7641 8-bit bytes (1698 36-bit words are equal to 7641 8-bit bytes). Additional words of documentation are added at the end of each record (in 8-bit configuration). These 8-bit bytes contain the same information as the first two 36-bit words

of the format described in paragraph f(2),but in the following form:

Byte No.	Information	Code
7624-25	Year	BCD, 1971 = 1971
7626-27	Month	BCD
7628-29	Day	BCD
7630-31	Hour	BCD
7632-33	Box number	BCD
7634-35	Record number for the box	BCD
7636	Hemisphere indicator	Binary zero = NH BCD S = SH
7636-7641	Zero Filled	

These documentation bytes are then used when processing the data on an 8-bit byte-oriented system and in producing the data availability catalog (noted earlier). This final file is the OL-A 3DNEPH SYNOPTIC FILE.

Within the 10 record groups for each box, there are four 36-bit pieces of information for each point (4 × 4096). The data are arranged by having all point parameters in the first 4096 data words (64 rows and 64 columns). This is followed by 4096 groups of three words which contain the layer information (15 layers) for each grid point. The information for the points (the first 4096 data words) and the groups of three words for layer information are stored by row in the same manner as the point data. The information in the 10 records is as follows:

Record	Beginning Data Word	Ending Data Word	Type of Information
1	3	1694	Point
2	3	1694	Point
3	3	714	Point
3	715	1674	Layer
4-9	3	1694	Layer
10	3	1178	Layer

The information for each data word for a point is as follows with bits numbered from left to right:

Byte Size	Bits	Information	Code	Missing Data
1	1		Not used	
4	2- 5	Low cloud type	0-15	15
3	6- 8	Mid cloud type	0- 7	7
3	9-11	High cloud type	0- 7	7
4	12-15	Present weather	0- 9	15
7	16-22	Max tops	00-99	127
7	23-29	Min bases	00-99	127
7	30-36	Total coverage	0-100	127

NOTE: Codes 15, 7, 7 designated as missing codes for low, middle, high cloud types are to be considered as missing, only when present weather, max tops, min bases, and total coverage contain their respective missing codes.

The information for layered cloud amounts is contained in three consecutive words. With bits numbered from left to right, they contain the following information:

Byte Size	Bits	Information	Layer	Code	Missing
1	1	Not used			
7	2- 8	Percent cloud	1	0-101	127
7	9-15	Percent cloud	2	0-101	127
7	16-22	Percent cloud	3	0-101	127
7	23-29	Percent cloud	4	0-101	127
7	30-36	Percent cloud	5	0-101	127

Data word 2 is the same as 1 for layers 6-10

Data word 3 is the same as 1 for layers 11-15.

Reformatted Time Series - Content and Format

The 3DNEPHNHA synoptic file is in a form that is not readily accessible to rapid retrieval of time sequential information for a point. Many of the USAFETAC studies require data in a localized geographical area as opposed to synoptic data (all the information for the hemisphere in sequence). Consequently, this requirement, coupled with a finite computer resource, made it necessary to reformat the synoptic file into a form that would achieve a savings in future computer resource needs and provide better requester response for these data.

The new form of the 3DNEPHNHA time series is designed around the 3DNEPH box concept (Figure 1). The new file is a continuous set of information for a box with a maximum of 60 boxes at any analysis time. The sequencing of data on a tape for a box is 00Z, 03Z, ... 21Z for day 1; 00Z, 03Z, ... 21Z for day 2; ... to present. This arrangement of information will give larger concentrations of data for the same geographical area on less tapes. To show the change that the reformatting will have on the computer resource needed, assume

the information for a small geographical area (10 points) is required. One day of synoptic files (8 analysis times) at present occupies about two tapes. The reformatted box time series will have all information for one month on one tape. To perform the data extract stated earlier the old method would require the mounting of 60 tapes as opposed to but one tape from the reformatted file. Based strictly on computer time there would be approximately a 1 to 15 ratio of savings for the data extract.

The tape format of the data in the box time file has been rearranged to improve data processing and retrieval. The box time-series tapes contain all the analysis times for one month and one box in sequence. Within each box there are 32 records of information with each record containing two rows of points (128 points).

The arrangement of information within each record is 13 bytes of documentation followed by 128 groups of 22 bytes of data, one group for each point. The documentation bytes are arranged as follows in hexadecimal display code:

Information	No. of Bytes (8-Bit Bytes)
Box number*	3
Year	2
Month	2
Day	2
Hour	2
Number of the record for that box	2

* 3DNEPHSHA Boxes (101-164)

The arrangement of the information for each point is as follows:

Byte	Information
1	Low cloud type
2	Middle cloud type
3	High cloud type
4	Present weather
5	Maximum tops
6	Minimum bases
7	Total coverage
8-22	Layered coverage

Missing data are indicated in the same way as the SYNOPTIC FILE. Thus, one record of 128 points (two rows) contains 2829 8-bit bytes of information.

Summarized File - Content and Format

The need for summarized 3DNEPHNHA information is required to answer many requests for summarized data in areas of sparse conventional data and which are only available in gridded format. To decrease response time for these requests, it was apparent that additional processing of the data would be required. The following paragraphs explain the content and tape format of this summarized file.

The summarized file is generated from the box time file. It is a set of frequency-of-occurrence histograms for monthly summaries at analysis hours over several years. There is one family of tapes for each box of data processed. There is a histogram for each parameter (22) for each point (4096/box) for each month (12) at each analysis time (8). Each histogram entry is an 8-bit byte (255_{10} count) so that eight years of data can be placed in any histogram entry for any variable (eight years times 31 days per month). In addition to the 22 parameters, one byte is used to count the number of days the information for that point and time were available. Table 4 describes the order that the histograms for each point appear in the data base, the information in the data base, the number of entries in each histogram, and the letter of the sub-table of Table 5 that defines the limits of the entries in each histogram.

Tables 5a, b, c, and d are taken from the original 3DNEPHNHA code tables (Tables 1a, b, c, and d of this appendix). Tables 5e and f are derived from WMO Table 1677 (Table 1e of this appendix). Tables 5g and h group the total and layered coverage to 5 and 10% intervals, respectively.

Table 4. Histogram Information

Order	Information	No. of 8-Bit Byte Entries	Applicable Part of Table 5
1	Days of data	1	none
2	Low cloud type	16	a
3	Middle cloud type	8	b
4	High cloud type	8	c
5	Present weather	10	d
6	Maximum tops	13	e
7	Minimum bases	14	f
8	Total coverage	21	g
9-23	Layered coverage	11 each	h

Table 5a. Code and Histogram Entry Number for Low Cloud Type.

Histogram Entry No.	Table Code	Type(s) of Cloud
1	0	Type unknown or not present
2	1	Stratocumulus (SC)
3	2	Stratus (ST)
4	3	Cumulus (CU)
5	4	Cumulonimbus (CB)
6	5	SC and ST
7	6	SC and CU
8	7	SC and CB
9	8	ST and CU
10	9	ST and CB
11	10	CU and CB
12	11	SC and ST and CU
13	12	SC and ST and CB
14	13	SC and CU and CB
15	14	ST and CU and CB
16	15	SC and ST and CU and CB

Table 5b. Code and Histogram Entry Number for Middle Cloud Type.

Histogram Entry No.	Table Code	Type(s) of Cloud
1	0	Type unknown or not present
2	1	Altocumulus (AC)
3	2	Altostratus (AS)
4	3	Nimbostratus (NS)
5	4	AC and AS
6	5	AC and NS
7	6	AS and NS
8	7	AC and AS and NS

Table 5c. Code and Histogram Entry Number for High Cloud Type.

Histogram Entry No.	Table Code	Type(s) of Cloud
1	0	Type unknown or not present
2	1	Cirrus (CI)
3	2	Cirrocumulus (CC)
4	3	Cirrostratus (CS)
5	4	CI and CC
6	5	CI and CS
7	6	CC and CS
8	7	CI and CC and CS

Table 5d. Code and Histogram Entry Number for 3DNEPH Present Weather.

Histogram Entry No.	Code Figure	Weather
1	0	No wea, haze, dust, sand, smoke
2	1	Mist, shal fog, lightning/no thun, precip in sight, t-storm, squalls, fun-cld
3	2	Precip, fog, ice fog, t-storm at station during past hr but not at time of obs
4	3	Duststorm, sandstorm - drifting or blowing snow
5	4	Fog or ice fog at time of obs
6	5	Drizzle (freezing or nonfreezing) at time of obs
7	6	Rain (freezing or nonfreezing) at time of obs
8	7	Solid precip not in showers at time of obs
9	8	Showery precip (rain and/or snow) at time of obs
10	9	Precip with current or recent thunderstorm

Table 5e. Code and Histogram Entry Number for Maximum Cloud Bases.

Histogram Entry No.	Height Code Entries	Height Range (ft)
1	0 thru 15	0- 1500
2	16 thru 20	1501- 2000
3	21 thru 30	2001- 3000
4	31 thru 50	3001- 5000
5	51 thru 58	5001- 8000
6	59 thru 60	8001-10000
7	61 thru 65	10001-15000
8	66 thru 70	15001-20000
9	71 thru 75	20001-25000
10	76 thru 80	25001-30000
11	81 thru 82	30001-40000
12	83 thru 85	40001-55000
13	86 thru 89	> 55000

Table 5f. Code and Histogram Entry Number for Minimum Cloud Bases.

Histogram Entry No.	Height Code Entries	Height Range (ft)
1	0 thru 5	0- 500
2	6 thru 10	501- 1000
3	11 thru 15	1001- 1500
4	16 thru 20	1501- 2000
5	21 thru 30	2001- 3000
6	31 thru 50	3001- 5000
7	51 thru 58	5001- 8000
8	59 thru 60	8001-10000
9	61 thru 65	10001-15000
10	66 thru 70	15001-20000
11	71 thru 75	20001-25000
12	76 thru 80	25001-30000
13	81 thru 82	30001-40000
14	83 thru 89	> 40000

Table 5g. Code and Histogram Entry Number for Total Cloud Coverage.

Histogram Entry No.	Percent
1	0
2	1- 5
3	6-10
4	11-15
5	16-20
6	21-25
7	26-30
8	31-35
9	36-40
10	41-45
11	46-50
12	51-55
13	56-60
14	61-65
15	66-70
16	71-75
17	76-80
18	81-85
19	86-90
20	91-96
21	96-100

Table 5h. Code and Histogram Entry Number for Layered Amounts.

Histogram Entry No.	Percent	Histogram Entry No.	Percent
1	0	7	55, 56*, 60, 61*
2	5, 6*, 10, 11*	8	65, 66*, 70, 71*
3	15, 16*, 20, 21*	9	75, 76*, 80, 81*
4	25, 26*, 30, 31*	10	85, 86*, 90, 91*
5	35, 36*, 40, 41*	11	95, 96*, 100, 101*
6	45, 46*, 50, 51*		

* These numbers denote thin clouds, i.e., 6 denotes 5% of thin clouds, 71 denotes 70% of thin clouds.

The histograms for one box for one month and for eight distinct times are contained on one tape; thus, 12 tapes are required for the climatology of one year for each box. The data are placed on each tape beginning with 00Z and continuing through 21Z. Entry for each time contains 32 records of data (two rows of points per record) stored by row. Within each record there are 27 bytes of documentation plus 16 points grouped together for a total of eight groups (128 points). The documentation for each record is arranged as follows with entries being in hexadecimal display code:

Byte	Information	Number of Entries
1- 3	Box number	3
4- 5	Month	2
6- 7	Hour	2
8-11	Number of tape records present for the box (1 tape record is 16 points) (1-256)	4
12-13	First year of data	2
14-15	Second year of data	2
16-17	Third year of data	2
18-19	Fourth year of data	2
20-21	Fifth year of data	2
22-23	Sixth year of data	2
24-25	Seventh year of data	2
26-27	Eighth year of data	2

Thus, one tape read will bring in the documentation for 128 points and the data for those two data rows. The arrangement of the data for each point is according to Column 1 of Table 4 and the number of entries in each histogram are according to the number of entries in Column 3 of Table 4.

Tape Specification

The tape specifications for each of the 3DNEPH data files are as follows:

a. OL-A 3DNEPH Synoptic Files:

Track = 9, odd parity
Density = 800 BPI
Mode = binary
Record length = fixed 7641 (8-bit bytes)
Blocked = no
Label = none
Begin tape mark = no
Sequence = YY-MM-DD-HH-BN-RC

b. Box-Time Series File:

Track = 9, odd parity
Density = 800 BPI
Mode = binary data, EBCDIC identification
Record length = fixed 2829 (8-bit bytes)
Blocked = 2
Label = none
Begin tape mark = no
Sequence = BN-YY-MM-DD-HH-RN

c. Summarized Histogram File:

Track = 9, odd parity
Density = 800 BPI
Mode = binary data, EBCDIC identification
Record length = fixed 4155 (8-bit bytes)
Blocked = 8
Label = none
Begin tape mark = no
Sequence = BN-MM-HH-RC

Appendix B

ANALYSIS DATA BASE SUMMARY

Introduction

The Air Force Global Weather Central (AFGWC) analyses stored at USAFETAC date back to the early 1960's. The original data were limited to the Northern Hemisphere and consisted of only a few parameters at several of the standard pressure levels. With the major upgrade in computer resources at AFGWC in 1970, more frequent analyses covering more geographical areas became available. Those were also stored at USAFETAC. This increase in data coverage, covering both time and area, added additional value to this stored data. Nevertheless, even though they were available, the analyses received only limited use at USAFETAC prior to 1973. Early use included point analysis along with a few other very limited applications. This limited use of what is now considered an excellent data base probably can be attributed to the fact that the real value of the analyses could not be adequately assessed until consistency and feasibility (usability) checks of each parameter were performed (Appendix C).

In June of 1973, USAFETAC applied the necessary resources to perform studies on the uses of these analyses, to verify the consistency of the data, and to develop formats that would provide rapid access to the stored data and facilitate its use in a wide variety of applications.

This appendix will address the following subjects:

- Time and Areal Coverage of the Analyses
- Interpolation Technique Used for Map Projection Consistency
- Parameters in the Analyses
- Initial Time Series
- File Formats and Tape Storage Requirements
- Data Quality Control
- The Summarized File

Time and Areal Coverage of the Analyses

Time Coverage

The analyses fields are available at USAFETAC in three distinct files as

they arrive from AFGWC. The three files consist of the Northern Hemisphere Analysis (NHA), the Southern Hemisphere Analysis (SHA), and the Tropical Weather Analysis (TWA). Each analysis always contains data for specified parameters. Other parameters are available but only in one or two of the three analyses.

The time coverage of the NHA is 6 hours, beginning at 00Z, 06Z, 12Z, and 18Z. The period of record (POR) of the NHA begins in 1966 and consists of 11 pressure levels. The number of parameters was increased and the number of levels analyzed in the NHA was increased in August 1970 to 15. The use of the NHA prior to January 1971 as part of the proposed analysis data base is questionable due to the model change of August 1970. Thus, the time series in the NHA for the data base will begin in January 1971. This beginning date for the NHA will also be more consistent with the POR's of the SHA and TWA.

The time coverage of the TWA is 12 hours, at 00Z and 12Z, beginning in August 1970 for 10 pressure levels. Analysis of four additional levels began in May of 1973. These additional levels make the TWA-analyzed levels the same as the NHA and SHA (850 mb and above). Tropics POR will begin January 1971.

The time coverage of the SHA is also 12 hours, beginning at 00Z and 12Z. It began in August 1971. The SHA employs a 15-level analysis model similar to that of the NHA. The POR of the SHA will begin in January 1972.

The 15-level SHA and NHA analyses contain one more level than the TWA which does not include an analysis for wind at the 1000-mb level. Since both the TWA and the SHA are analyzed every 12 hours, the 06Z and 18Z analyses of the NHA will not be used in the time files in order to maintain consistency in analysis times throughout and to minimize the difficulty of interpolation.

Areal Coverage

The next several paragraphs describe the areal coverage of each of the analyses. The combined areal coverage of the NHA, SHA, and TWA is global with overlap in the latitude range from 10-30 degrees, north and south.

The NHA projection (Figure 1) is polar stereographic with a scale of 1:20,000,000 at 60°N. The projection is oriented such that 80°W longitude (prime meridian) is oriented from the pole perpendicular to the bottom of the map. All data are contained within the octagon shown (1977 points). When the octagon is changed to a rectangle (dotted lines), it contains 47 columns and 51 rows (2397 points). In this 47 by 51 array, the North Pole is column #24 on row #26. Numbering from the North Pole, any point (1977 points) in the octagon can be given an I (column), J (row) location within the 47 by 51 array. However, the area represented by a point varies with the latitude of that point. At 45°N, a point represents a square area 200 nm on a side. The area

represented by a point decreases at latitudes less than 45°N and increases at latitudes greater than 45°N.

Table 1. Latitude of TWA-Numbered Rows.

Row #	Latitude
1	40.97N
2	37.1 N
3	33.0 N
4	28.7 N
5	24.2 N
6	19.6 N
7	14.8 N
8	9.9 N
9	5.0 N
10	0.0 N
11	5.0 S
12	9.9 S
13	14.8 S
14	19.6 S
15	24.2 S
16	28.7 S
17	33.0 S
18	37.1 S
19	40.97S

Figure 2 is a representation of the SHA map projection. It has the same 1:20,000,000 scale as the NHA. It also contains 1977 points inside the octagon. The orientation of the SHA map has 100°E as the prime meridian. When the NHA map is placed above the SHA map, 80°W connects the North Pole with the South Pole. These orientations will become important when we consider the TWA.

Figure 3 is a representation of the TWA map projection. It is a 1:20,000,000 mercator projection. There is a total of 73 columns and 19 rows of data (1368 distinct points). The data are stored by rows from 0° westward. The information for 0° is stored in the first and last column of each row so that only the first 72 columns are used. When the data for a parameter are plotted on the 1:20,000,000 mercator map, the distance between each point in a row is 1 inch; thus, the 72 columns are at every 5 degrees of longitude. To maintain 1-inch spacing between points in the columns, the 19 rows are at the latitudes indicated in Table 1.

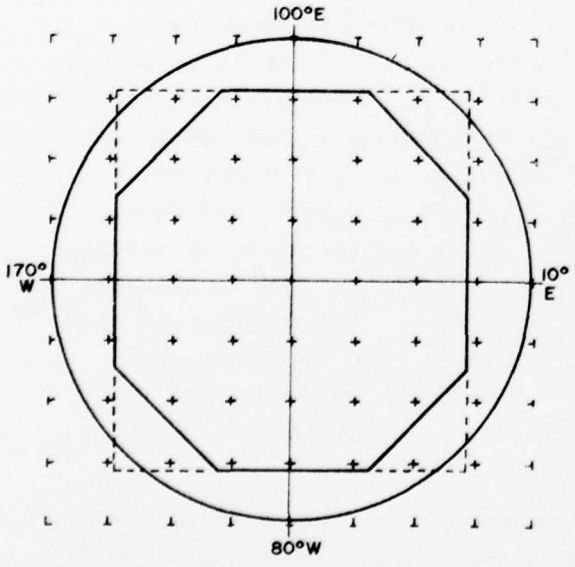


Figure 1. NHA Map Projection.

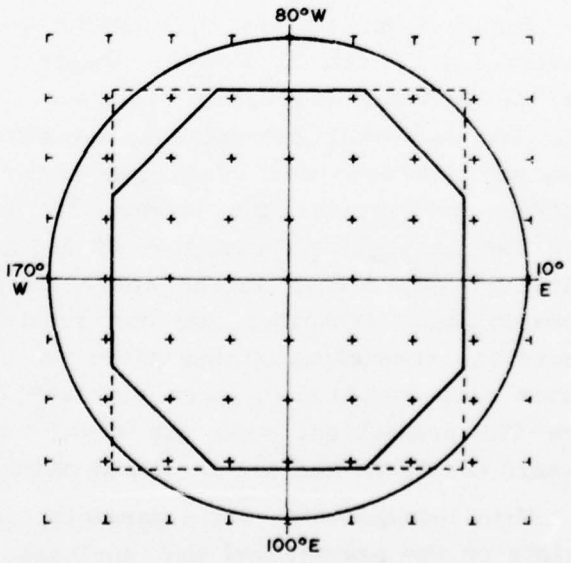


Figure 2. SHA Map Projection.

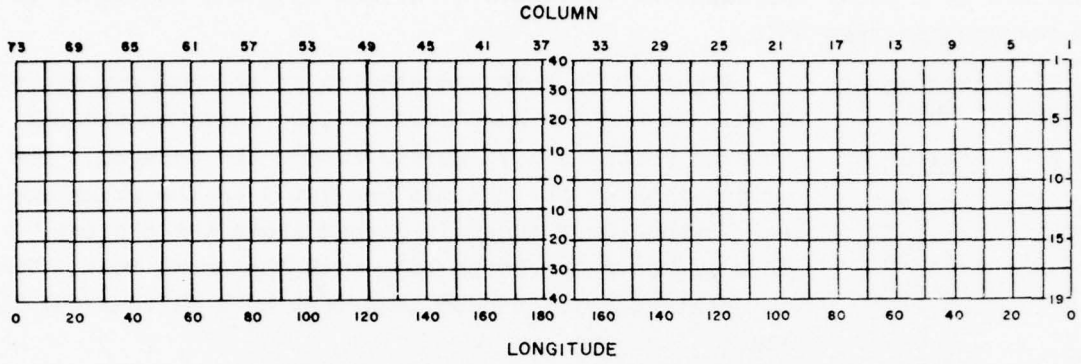


Figure 3. TWA Map Projection.

Interpolation Technique Used for Map Projection Consistency

The 3DNEPH (Appendix A) is presented on the polar stereographic map described earlier. It contains 64 analysis points for each analysis point of the NHA. The major problem involved is that the 3DNEPH is analyzed in the tropical areas also on a polar stereographic projection; thus, no compatible data are available for that area since the TWA is on a mercator projection. To provide a compatible data base in the tropics, a remapping of the TWA mercator projection to the polar stereographic projection of the NHA and SHA is desirable.

Figure 4 depicts the overlapping portion of the Northern Hemisphere Analysis and Tropical Weather Analysis . An identical overlap is presented by the Southern Hemisphere Analysis. To avoid data discontinuities between the two different projections, an AFGWC blend criteria is used such that NHA and SHA are used north and south of latitude 33.0, a blend of NHA/SHA and TWA are used between latitudes 24.2 and 33.0 North and South, and TWA is utilized between 24.2N and 24.2S. After consideration of several alternatives, double linear interpolation was found to provide a suitable interpolation technique for our remapping procedure. In arriving at this decision, consideration was given to data accuracy, the excessive computer time required by more sophisticated techniques, and the fact that the TWA projection, with its equal spacing between grid points, lends itself easily to the double-linear method.

When interpolation for a parameter is complete, there will be data for all points on the new octagon that encloses the entire hemisphere either northern or southern (Figure 4). Now, the I (columns) and J (rows) will be referenced in a 64 by 64 array (dotted lines) instead of the earlier 47 by 51 of the

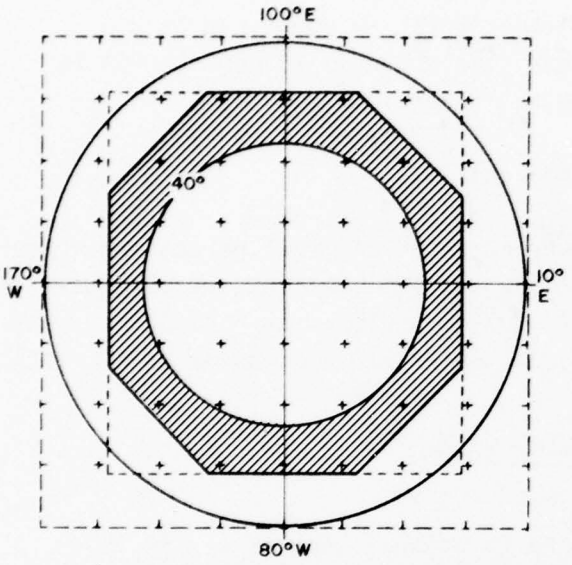


Figure 4. The Overlapping Portion of the NHA and TWA.

original octagon of Figures 1 and 2. The North Pole and the South Pole are point 33 on line 33 in their respective 64 by 64 array.

The actual remapping procedure will have NHA, SHA, and TWA as simultaneous inputs for the same parameter and time. Each point in the 64 by 64 array of the NHA or SHA will fall within a group of four points of the TWA, between 40.97 N and S. The information for the parameter at the four surrounding points will be interpolated to the desired location and become the value placed in the appropriate position in the NHA and SHA 64 by 64 array. The four TWA points that surround each NHA or SHA point can be predetermined. In addition, because of the 1-inch interval on the TWA, predetermined constants can be calculated which specify the NHA or SHA point in relation to the four TWA points so that, at execution time, the constants can be applied to a single arithmetic statement and the desired value will result.

An example (Figure 5) of the generalized equation for the interpolation and a schematic follows:

where M1, M2, M3, and M4 are values for a TWA parameter.

N1 is the interpolated value on the NHA or SHA grid.

D1, D2, D3, and D4 are the weighting factors. D1 is a portion of the unit distance between M1 and M2. D1 + D2 = 1.

The equation for the interpolation is:

$$N1 = D4(D2M1 + D1M2) + D3(D2M3 + D1M4)$$

After the necessary remapping of the Northern Hemisphere is completed, our parameter field is now compatible with that of the Northern Hemisphere 3DNEPH. As earlier stated, 64 3DNEPH points are present for each NHA or SHA point, such that every 9th I (column) and every 9th

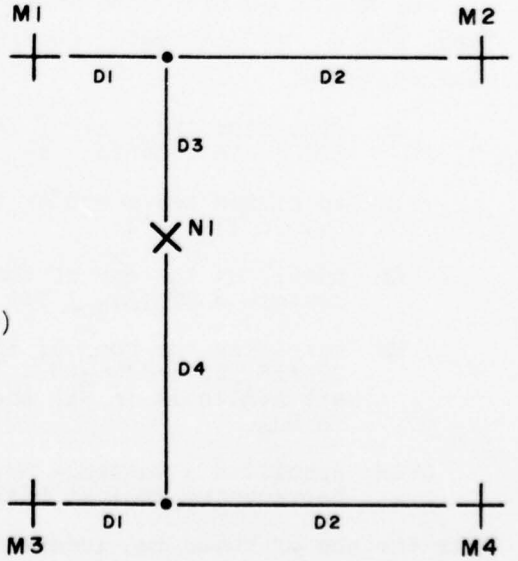


Figure 5. Double-Linear Interpolation Schematic.

J (row) of the 3DNEPH correspond to a NHA or SHA point. Since the remapped NHA/SHA is contained in a 64 by 64 array, the 3DNEPH is contained in a 512(64×8) by 512(64×8). Thus, a 3DNEPH box (see Appendix A) contains 64×64 3DNEPH points which are equivalent to 8×8 NHA/SHA points.

Parameters in the Analysis

The NHA, SHA, and TWA contain a variety of meteorological parameters. Each parameter field contains two identification words (36 bits) at the beginning of each array (47 by 51 NHA and SHA, 73 by 19 TWA). One word specifies the field and the other specifies the date/time group. The field designator is a 6-digit octal code. Entries are as follows:

Field Designator Word

ABCDEF - First Control Word

AB for all analysis fields, AB is 00 to indicate analysis. A 12 would indicate a 12-hour forecast field for the parameter(s).

C specifies the analysis being considered. A is NHA, H is SHA, and T is for TWA.

D specifies the parameter(s) following this label word (many fields contain two parameters for each point per computer word.

EF specifies the pressure level(s) of the parameter(s) following the label word.

GHIJKLMNOPQR - Date/Time Word

The second control word is a binary word containing the year, month, day, hour, and an ETAC-generated sequence number for this array. The format is explained below:

GH specifies the year of the analysis time (year - 1960) so that 1972 data contain a 14_8 in GH.

IJ specifies the month of the analysis time. November data contain a 13_8 in IJ.

KL specifies the day of the month of the analysis. KL would contain a $37_8(31_{10})$ for data of the 31st day of the month.

MN specifies the hour of the analysis $06_8(06_{10})$, $14_8(12_{10})$, $22_8(18_{10})$, and $00_8(00_{10})$ in Z time; only 00Z and 12Z data are available in SHA and TWA with all four times available in NHA.

OPQR specifies a sequence number for this record and is a local bookkeeping tool at USAFETAC.

With the use of these two identification words, any parameter at any level and at any time can be specified. Using the ABCDEF word, the following parameters

can be specified with the following control words:

for NHA ABC always is 00A
for SHA ABC always is 00H
for TWA ABC always is 00T

The following label words (ABCDEF) are associated with the following analysis fields and are indicated as follows:

for NHA use Table 2
for SHA use Table 3
for TWA use Table 4

All the fields listed in Tables 2, 3, and 4 are available at any time. Because of operational constraints and hardware problems, some or all of the fields for an analysis time might be missing. A catalog of all missing data is being maintained since the beginning of the period of record for 00Z and 12Z analysis times.

Table 2. Northern Hemisphere Analysis.
(36-bit word divided into two 18-bit halves)

Label Word	Level	Left Half (bits 35-18)	Units	Right Half (bits 17-00)	Units
00APSF	Sfc	Pressure	mb × 10	Temperature	Deg K × 10
00AZ00	1000 mb	D-Value	Meters × 10	Sfc Temp	Deg K × 10
00AZ85	850 mb	D-Value	Meters × 10	Temperature	Deg K × 10
00AZ70	700 mb				
00AZ50	500 mb				
00AZ40	400 mb				
00AZ30	300 mb				
00AZ25	250 mb				
00AZ20	200 mb				
00AZ15	150 mb	D-Value	Meters × 10	Temperature	Deg K × 10
00AZ10	100 mb				
00AZ07	70 mb				
00AZ05	50 mb				
00AZ03	30 mb				
00AZ02	20 mb				
00AZ01	10 mb				
00AW00	1000 mb				
00AW85	850 mb				
00AW70	700 mb				
00AW50	500 mb				
00AW40	400 mb				
00AW30	300 mb				
00AW25	250 mb				
00AW20	200 mb				
00AW15	150 mb	U-wnd comp	m/sec × 10	V-wnd comp	m/sec × 10
00AW10	100 mb				
00AW07	70 mb				
00AW05	50 mb				
00AW03	30 mb				
00AW02	20 mb				
00AW01	10 mb				

Table 2. Northern Hemisphere Analysis (Cont'd).

(36-bit word divided into two 18-bit halves)

Label Word	Left Half	Units	Right Half	Units
00AD87	850-mb Dew-Point Depression	Deg K × 10	700-mb Dew-Point Depression	Deg K × 10
00AD53	500-mb Dew-Point Depression	Deg K × 10	400-mb Dew-Point Depression	Deg K × 10
00A070	1000-850 mb Vertical Velocity	mb/sec × 10^4	850-700 mb Vertical Velocity	mb/sec × 10^4
00A030	700-500 mb Vertical Velocity	mb/sec × 10^4	500-300 mb Vertical Velocity	mb/sec × 10^4
00A010	300-200 mb Vertical Velocity	mb/sec × 10^4	200-100 mb Vertical Velocity	mb/sec × 10^4
00AA12	Sfc-850 mb Precipitable Water	Inches of Water × 10	850-700 mb Precipitable Water	Inches of Water × 10
00AA34	700-500 mb Precipitable Water	Inches of Water × 10	500-300 mb Precipitable Water	Inches of Water × 10
00AA56	BLANK	-------	300-100 mb Precipitable Water	Inches of Water × 10
00AZSS	BLANK	-------	Sea Surface Temperature	Deg K × 10

(36-bit word divided into four parts)

Label Word	9 Bits	9 Bits	9 Bits	9 Bits	Units
00AR00	Height of Contrail Base Lowest Layer	Height of Contrail Top Lowest Layer	Height of Contrail Base Second Layer	Height of Contrail Top Second Layer	Meters × 10^{-2}

(36-bit word divided into six variable parts)

Label Word	10 Bits	4 Bits	4 Bits	10 Bits	4 Bits	4 Bits	CODES
00A187	Precip.	850 mb Cloud Types	Icing	BLANK	700 mb Cloud Types	Icing	AWSM 105-24
00A153	BLANK	500 mb Cloud Types	Icing	BLANK	300 mb Cloud Types	Icing	

(36-bit word divided into three equal parts)

Label Word	12 Bits	Units	12 Bits	Units	12 Bits	Units
00AL00	Pressure at Tropopause	mb	Height of Tropopause	Deca-meters	Temperature at Tropopause	Deg K × 10

(single 36-bit word)

Label Word	36 Bits	Units
00ADSF	Surface Dew-point Depression	Deg K
00AV50	500-mb Vorticity	sec^{-1}

Table 3. Southern Hemisphere Analysis.

(36-bit word divided into two 18-bit halves)

Label Word	Level	Left Half	Units	Right Half	Units
00HPSF	Sfc	Pressure	mb × 10	Sfc Temp	Deg K × 10
00HZ00	1000 mb	D-Value	Meters × 10	Sfc Temp	Deg K × 10
00HZ85	850 mb	D-Value	Meters × 10	Temperature	Deg K × 10
00HZ70	700 mb				
00HZ50	500 mb				
00HZ40	400 mb				
00HZ30	300 mb				
00HZ25	250 mb				
00HZ20	200 mb				
00HZ15	150 mb				
00HZ10	100 mb				
00HZ07	70 mb				
00HZ05	50 mb				
00HZ03	30 mb				
00HZ02	20 mb				
00HZ01	10 mb				
00HW00	1000 mb	U-wnd comp	m/sec × 10	V-wnd comp	m/sec × 10
00HW85	850 mb	U-wnd comp	m/sec × 10	V-wnd comp	m/sec × 10
00HW70	700 mb				
00HW50	500 mb				
00HW40	400 mb				
00HW30	300 mb				
00HW25	250 mb				
00HW20	200 mb				
00HW15	150 mb				
00HW10	100 mb				
00HW07	70 mb				
00HW05	50 mb				
00HW03	30 mb				
00HW02	20 mb				
00HW01	10 mb				

(36-bit word divided into two 18-bit halves)

Label Word	Left Half	Units	Right Half	Units
00HPSF	Sfc Pressure	mb × 10	Sfc Temperature	Deg K × 10
00H070	1000-850 mb Vertical Velocity	mb/sec × 10^4	850-700 mb Vertical Velocity	mb/sec × 10^4
00H030	700-500 mb Vertical Velocity	mb/sec × 10^4	500-300 mb Vertical Velocity	mb/sec × 10^4
00H010	300-200 mb Vertical Velocity	mb/sec × 10^4	200-100 mb Vertical Velocity	mb/sec × 10^4
∧ 00HD87	850-mb Dew-Point Depression	Deg K × 10	700-mb Dew-Point Depression	Deg K × 10
∧ 00HD53	500-mb Dew-Point Depression	Deg K × 10	400-mb Dew-Point Depression	Deg K × 10

(single 36-bit words)

Label Word	36 Bits	Units
∧ 00HDSF	Sfc Dew-Point Depression	Deg K
00HV50	500-mb Vorticity	sec^{-1}

∧ POR from April 1974.

Table 4. Tropical Weather Analysis

(36-bit word divided into two 18-bit halves)

Label Word	Level	Left Half (bits 35-18)	Units	Right Half (bits 17-00)	Units
00TPSF	Sfc	Pressure	mb × 10	Sfc Temp	Deg K × 10
00TZ00	1000 mb	D-Value	Meters × 10	Sfc Temp	Deg K × 10
00TZ85	850 mb				
00TZ70	700 mb				
00TZ50	500 mb				
00TZ40	400 mb				
00TZ30	300 mb				
00TZ25	250 mb				
00TZ20	200 mb				
00TZ15	150 mb	D-Value	Meters × 10	Temperature	Deg K × 10
00TZ10	100 mb				
* 00TZ07	70 mb				
00TZ05	50 mb				
* 00TZ03	30 mb				
* 00TZ02	20 mb				
* 00TZ01	10 mb				
00TW85	850 mb				
00TW70	700 mb				
00TW50	500 mb				
00TW40	400 mb				
00TW30	300 mb				
00TW25	250 mb				
00TW20	200 mb				
00TW15	150 mb	U-wnd comp	m/sec × 10	V-wnd comp	m/sec × 10
00TW10	100 mb				
* 00TW07	70 mb				
00TW05	50 mb				
* 00TW03	30 mb				
* 00TW02	20 mb				
* 00TW01	10 mb				
Δ 00TD87		850-mb D-P Depression	Deg K × 10	700-mb D-P Depression	Deg K × 10
Δ 00TD53		500-mb D-P Depression	Deg K × 10	400-mb D-P Depression	Deg K × 10
00T070 00T030 00T010		NOT AVAILABLE but will have same format as NHA.			

(single 36-bit word)

Label Word	36 Bits	Units
Δ 00TDSF	Sfc Dew-Point Depression	Deg K

(36-bit word divided into three equal parts)

Label Word	12 Bits	Units	12 Bits	Units	12 Bits	Units
00TL00	Pressure at Tropopause	mb	Height of Tropopause	Deca-meters	Temperature at Tropopause	Deg K × 10

* POR from May 1973.
Δ POR from April 1974.

Table 4. Tropical Weather Analysis (Cont'd).

(36-bit word divided into four parts)

Label Word	9 Bits	9 Bits	9 Bits	9 Bits	Units
00TR00	Height of Contrail Base Lowest Layer	Height of Contrail Top Lowest Layer	Height of Contrail Base Second Layer	Height of Contrail Top Second Layer	Meters $\times 10^{-2}$

The Initial Time Series

The initial time series of the analyses data base will contain six parameters. Five of these parameters are the temperature, D-value, the U- and V-wind components, and surface pressure for the following levels:

Height	D-Value	Temperature	U- and V-Component
1000 mb	NHA/SHA/TWA	NHA/SHA/TWA	NHA/SHA
850 mb	all parameters included in all analyses		
700 mb			
500 mb			
400 mb			
300 mb			
250 mb			
200 mb			
150 mb			
100 mb			
70 mb			
50 mb			
30 mb			
20 mb			
10 mb			

In addition to the above parameters, dew-point depression for five levels will be included pending completion of a feasibility study of their usefulness. In areas of the analyses where some of these fields are not currently available, "missing data" flags will be used. All other analysis fields will be archived in the original format and be included in the data base as required.

File Formats and Tape Storage Requirements

The overall format of the time file will be to group the data by 3DNEPH boxes for each time in sequencing order of box number for a maximum of 60 boxes (boxes 1, 8, 57, and 64 are off the disk) (Appendix A). Each 3DNEPH box will be arranged by having all the information for one point together. Each data record will begin with documentation and the information for two rows of points within the box (16 points). There will be four such data records for each 3DNEPH box (64 points).

The documentation for each record will be as follows in hexidecimal display code:

Information	No. of Bytes (8-bit bytes)
Year	2
Month	2
Day	2
Hour	2
Box number	3*
Record number	1

* 3DNEPHSHA Boxes (101-164)

There is a total of 12 bytes for the documentation on each record.

The data for a point are arranged in the following order in binary form:

Information	No. of Bytes (8-bit bytes)
Surface pressure (1)	4
Surface temperature (1)	2
D-value (1000-10 mb (15))	2
Temperature (1000-10 mb (15))	2
U-component (1000-10 mb (15))	2
V-component (1000-10 mb (15))	2
Dew-point depressions (5)	2

All units are the same as stated earlier with the exception of the D-value fields which have been converted to whole meter since the range of D-value to meters × 10 can be larger than two bytes can hold. The above arrangement gives a maximum of 67 pieces of information at each point. Total storage requirement for the NHA and the SHA is two tapes each per month. The tape sequence for the NHA will contain 12-hourly analyses (00 and 12) with a POR beginning in January 1971. The SHA will contain remapped tropical data and the Southern Hemisphere within the octagon will be added with a POR beginning in January 1972.

Data Quality Control

The gridded analysis data base undergoes gross checks in the AFGWC analysis cycle so that the only spurious data that will be present are from tape reading and writing or from a mislabeled field. Thus, to take advantage of the gross error check at AFGWC, another gross error check will identify only inaccuracies derived from improper labeling or tape errors.

The limits of acceptable data were developed from the studies performed in Appendix C. Data falling within the following limits will be retained:

D-value	2000 meters to -3500 meters
Temperature	60°C to -130°C
U and V wind components	150 m/sec to -150 m/sec
Dew-point depression	55°C to 0
Grid-point surface pressure	1100 mb to 500 mb

These gross error checks will be during the remapping and merging cycle. All information that does not meet the criteria noted above will be eliminated with the appropriate missing-data flag.

The Summarized File*

The remapped, merged, and quality-controlled data base described in this appendix will become the basis for a summarized file. The summarized file of the analysis data base could be in a histogram format or it could be a summation of the parameters, summation of the parameter squared, and NUMBER OF OBS. Tape storage requirements for a full histogram file would be excessive. Therefore, the summarized file will be used that will consist of the summations noted earlier which fulfill many of the requirements of a summarized data base. The use of the histogram approach to summarization will be reserved for tailored application for specific parameters and areas and can be generated as required.

The summarized file (summation of the parameter, summation of the parameter squared, and the observation count) will be stored by month (Jan to Dec), time (00 to 12Z combined), and parameter (1-67). The parameters will be those designated in the time file with one exception. Actual dew points will be summarized in place of dew-point depressions. Each month-time-parameter will contain 64 records (rows) of 64 points (an entire hemisphere). Thus, an entire hemisphere for a month-time-parameter will be stored together. The configuration of each record will be 24 bytes of documentation as follows, with entries being in hexidecimal display code:

Byte	Information	Number of Entries
1-2	Parameter	2
3-4	Month	2
5-6	Hour	2
7-8	Row number	2
9-10	First year of data	2
11-12	Second year of data	2

(Cont'd)

(Display code continued):

Byte	Information	Number of Entries
13-14	Third year of data	2
15-16	Fourth year of data	2
17-18	Fifth year of data	2
19-20	Sixth year of data	2
21-22	Seventh year of data	2
23-24	Eighth year of data	2

Thus, one tape read will bring in the documentation for 64 points (1 row) and the data for each point. The data for each point will require 16 bytes of storage to hold the three summations. This file will require one tape per month per hemisphere for a total of 24 tapes. As new data are accumulated, the summarized file will be updated routinely.

Appendix C

THE USEFULNESS OF THE GRIDDED CONVENTIONAL DATA BASE FOR CLIMATIC APPLICATION

Introduction

For the past several years the USAF Environmental Technical Applications Center (USAFETAC) has been receiving and storing global analyses data on electronic computer tapes for the Air Force Global Weather Central (AFGWC). Presently, it is believed that a sufficient period of record for these data has been acquired to consider the data as a source of worldwide climatological information. General awareness of this source of data has suggested certain data formats and brought forth requirements for its utilization. The proposed application of global analyses to environmental problems and the requirement of format compatibility with the 3DNEPH dictated the resulting data base to be in two distinct formats. The application of the data to simulations and time relationships of parameters necessitated the data base to be in a time series that would have rapid retrieval characteristics, thus eliminating extensive computer search time. On the other hand, application of the data to problems that require basic statistical parameters at a point over a period of time can best be accomplished by a summarized format of the analyses.

This appendix describes and discusses the following:

- Input Data Base
- Scope of the Feasibility Study
- Grouped Data vs Ungrouped Data
- Station Data vs Analyses Data
- Limitations of the Comparisons

Input Data Base

The AFGWC global,operational,numerical analyses consist of three distinct data files, the Northern Hemispheric Analysis (NHA), the Southern Hemispheric Analysis (SHA), and the Tropical Weather Analysis (TWA). Construction of these analyses are completed at least every 12 hours.

The NHA input used in this study comes from two different periods of record (POR) beginning with January 1966. Prior to August 1970, the NHA contains temperature, D-Value, and a variety of other parameters, but does not include U and V wind components for the 1000-, 850-, 700-, 500-, 400-, 300-, 200-, 100-, 50-, 30-, and 10-mb levels. In August 1970, AFGWC introduced an oper-

ational 15-level model which included the 250-, 150-, 70-, and 20-mb levels, plus the addition of more parameters including the U-and V-wind components. These data are available at 00, 06, 12, and 18Z.

The SHA is a mirrored image of the NHA. It is derived exclusively from the 15-level model and contains all the information available in the NHA. The period of record for the SHA begins in August 1971. These data are available at 00 and 12Z.

The TWA analysis was developed at AFGWC in 1969 to complete the global grid-point analysis coverage. This file contains most of the parameters in the NHA and SHA, in addition to stream function fields. The period of record of the TWA begins in August 1970. The TWA is available for ten pressure levels prior to May 1973 and includes the 850-, 700-, 500-, 400-, 300-, 250-, 200-, 150-, 100-, and 50-mb levels. In May of 1973, temperatures, D-values, and U- and V-wind components for the 70-, 30-, 20-, and 10-mb levels were added. These data are available for 00 and 12Z. A complete list of parameters available in each analysis is shown in Table 4, Appendix B of this report.

Special treatment must be given to the wind components before they can be used. The wind components in the NHA and SHA are in grid coordinates. The relationship between grid coordinates and conventional coordinates (U, positive from the west and V, positive from the south) for the NHA and SHA are displayed in Figures 1a and 1b at 10°E. Since the relationship between the two coordinate systems is a function of longitude on the projections, therefore, the only place that grid components are equal to the conventional components is at 80°W

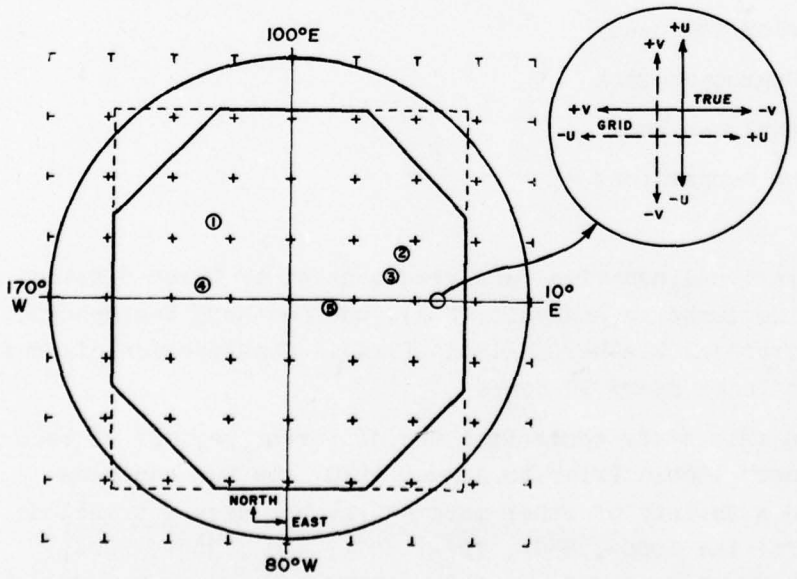


Figure 1a. The Relationship Between Grid Coordinates and Conventional Coordinates for the NHA.

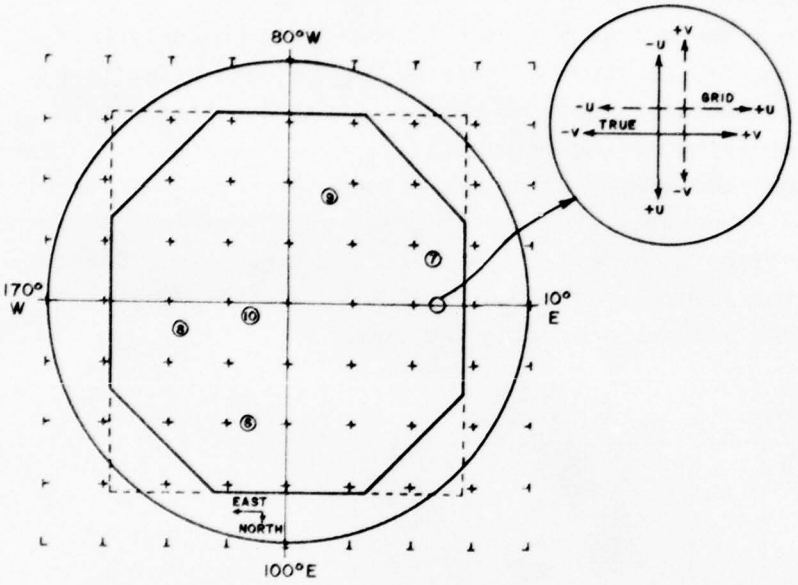


Figure 1b. The Relationship Between Grid Coordinates and Conventional Coordinates for the SHA.

in the NHA. Figure 1c indicates the relationship between the TWA grid and the conventional components. All U- and V-wind components displayed in this appendix are in conventional coordinates.

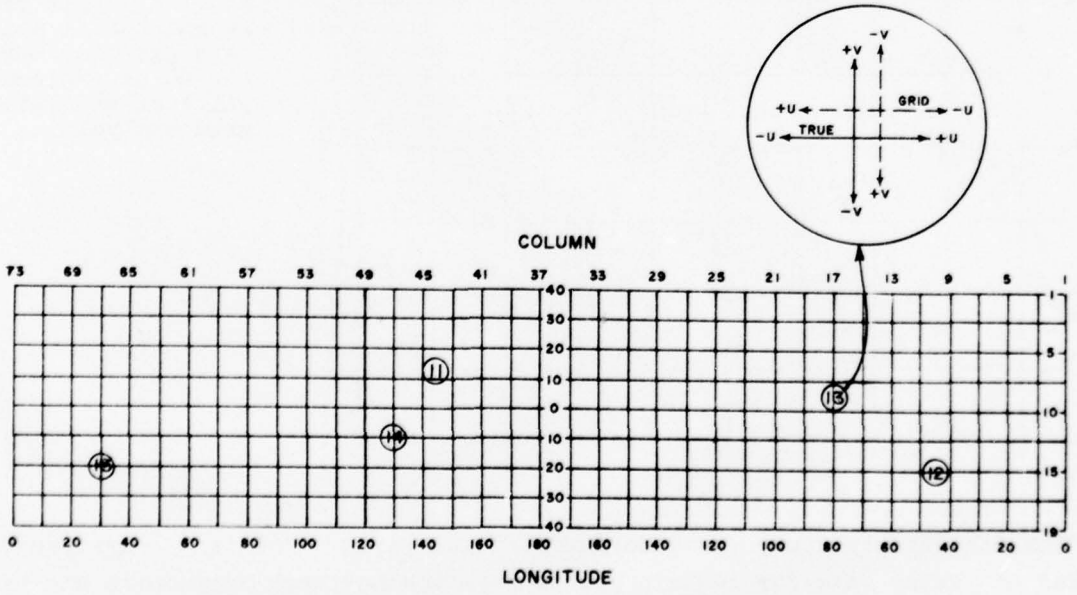


Figure 1c. The Relationship Between the TWA Grid and Conventional Components.

D-value is defined as the difference between the standard height of a pressure level and the actual height. The sign is determined by algebraically subtracting the standard height from the actual height.

Scope of the Feasibility Study

Once it was decided that the global analyses of the Northern Hemisphere, Southern Hemisphere, and the Tropics were to be used as the data base, feasibility studies had to be completed. The time-series output format shown in Appendix B is simply a reordering of the data as it arrives from AFGWC. Therefore, the major part of the feasibility study was directed towards methods of grouping the data for quality control, for a comparison of the different times (00Z and 12Z), and a comparison with specific station climatologies. The comparison of the two times was accomplished to determine if it was possible to group the two separate times without degrading the data.

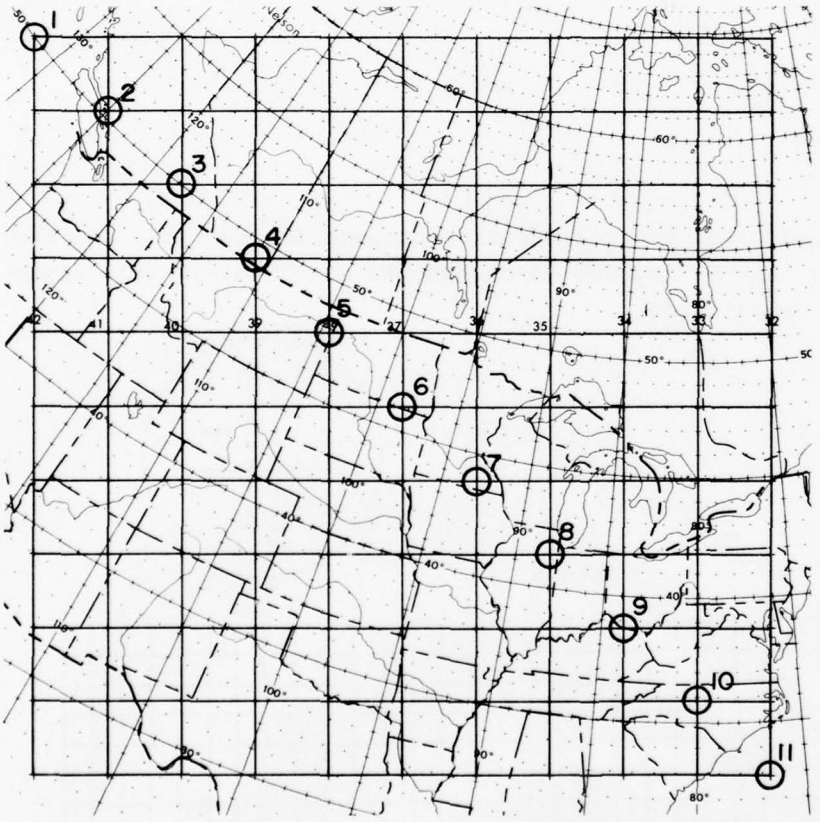


Figure 2. AFGWC-box #44. Numerals represent the 11 points on a diagonal through box 44 as representative of mid-latitude grid analysis.

The feasibility study was undertaken in two parts. The first part consisted of taking data for certain points from the Northern Hemisphere Analysis (see Figure 2) to develop histograms. The range and interval size of the histogram should be such that one histogram per parameter could be used for any latitude or altitude. Data used in the initial portion of the feasibility study were for various grid points, months, and times. These are presented in Table 1. Four parameters at each point and at each level were used (when

Table 1. Data Used in Study.

(Period of Record for the Months of Jan and Jul for 0000Z in Years)

Pressure Level(mb)	Temperature		D-Value		U-Component(wnd)		V-Component(wnd)	
	Jan	Jul	Jan	Jul	Jan	Jul	Jan	Jul
1000	8	8	8	8	3	3	3	3
850	8	8	8	8	3	3	3	3
700	8	8	8	8	3	3	3	3
500	8	8	8	8	3	3	3	3
400	8	8	8	8	3	3	3	3
300	8	8	8	8	3	3	3	3
250	3	3	3	3	3	3	3	3
200	8	8	8	8	3	3	3	3
150	3	3	3	3	3	3	3	3
100	8	8	8	8	3	3	3	3
70	3	3	3	3	3	3	3	3
50	8	8	8	8	3	3	3	3
30	8	8	8	8	3	3	3	3
20	3	3	3	3	3	3	3	3
10	8	8	8	8	3	3	3	3

available) and included temperature, D-value, and U- and V-wind components. Although the other parameter fields listed in Appendix B are in the original time-series format, a more extensive investigation of them is necessary before they can be included in the reformatted data base.

Grouped Versus Ungrouped

The main use of statistical analysis in climatology has always involved standard statistical parameters such as the mean and standard deviation. However, if one uses frequency distributions, more information is retained and the distribution of the parameters is implicit and does not have to be assumed. Thus, studies requiring a frequency of occurrence employ the actual distribution function. The primary use of the distribution function (grouping the data) in this study is for quality control. The grouping will indicate data that are not consistent with the distribution, but which would be used if the simple mean and standard deviation were the only elements saved from the original data.

The development of an initial interval size for each parameter at each level was accomplished to lend itself to automated analysis and testing and to hold down the number of distributions to be considered. The interval and range of the histogram was so designed that only one histogram is needed for each parameter. Table 2 lists the parameters and mid-points of the initial intervals. The distribution function would then appear in different positions of the histogram as the atmospheric level changed and only a small portion of the total histogram would be used at any one location, time of year, or altitude.

Table 2. Intervals and Mid-points of the Parameters

Interval Number	Temperature Mid-Point (°C)	D-Values Mid-Point(m)	U-Component Mid-Point (m/sec)	V-Component Mid-Point (m/sec)
1	-80.0	-1175.0	-59.5	-59.5
2	-77.0	-1125.0	-55.5	-55.5
3	-74.0	-1075.0	-51.5	-51.5
4	-71.0	-1025.0	-47.5	-47.5
5	-68.0	- 975.0	-43.5	-43.5
6	-65.0	- 925.0	-39.5	-39.5
7	-62.0	- 875.0	-35.5	-35.5
8	-59.0	- 825.0	-31.5	-31.5
9	-56.0	- 775.0	-27.5	-27.5
10	-53.0	- 725.0	-23.5	-23.5
11	-50.0	- 675.0	-19.5	-19.5
12	-47.0	- 625.0	-15.5	-15.5
13	-44.0	- 575.0	-11.5	-11.5
14	-41.0	- 525.0	- 7.5	- 7.5
15	-38.0	- 475.0	- 3.5	- 3.5
16	-35.0	- 425.0	+ 1.5	+ 1.5
17	-32.0	- 375.0	+ 5.5	+ 5.5
18	-29.0	- 325.0	+ 9.5	+ 9.5
19	-26.0	- 275.0	+13.5	+13.5
20	-23.0	- 225.0	+17.5	+17.5
21	-20.0	- 175.0	+21.5	+21.5
22	-17.0	- 125.0	+25.5	+25.5
23	-14.0	- 75.0	+29.5	+29.5
24	-11.0	- 25.0	+33.5	+33.5
25	- 8.0	+ 24.0	+37.5	+37.5
26	- 5.0	+ 74.0	+41.5	+41.5
27	- 2.0	+ 124.0	+45.5	+45.5
28	+ 1.0	+ 174.0	+49.5	+49.5
29	+ 4.0	+ 224.0	+53.5	+53.5
30	+ 7.0	+ 274.0	+57.5	+57.5
31	+10.0	+ 324.0	+61.5	+61.5
32	+13.0	+ 374.0	+65.5	+65.5
33	+16.0	+ 424.0	+69.5	+69.5
34	+19.0	+ 474.0	+73.5	+73.5
35	+22.0	+ 524.0	+77.5	+77.5
36	+25.0	+ 574.0	+81.5	+81.5
37	+28.0	+ 624.0	+85.5	+85.5
38	+31.0	+ 674.0	+89.5	+89.5
39	+34.0	+ 724.0	+93.5	+93.5
40	+37.0	+ 774.0	+97.5	+97.5

A typical set of distribution functions of temperature for a point appears in Table 3.

To test the reliability of the grouping method, a series of grid points (Figure 2) were extracted from the data for July and January. The entire POR

Table 3. Six-Level Temperature Distribution of the Northern Hemisphere

Temperature	1000 mb	850 mb	700 mb	300 mb	100 mb	10 mb	1000 mb	850 mb	700 mb	300 mb	100 mb	10 mb
			January						July			
-80	0	0	0	0	0	0	0	0	0	0	0	0
-77	0	0	0	0	0	0	0	0	0	0	0	0
-74	0	0	0	0	0	0	0	0	0	0	0	0
-71	0	0	0	0	0	0	0	0	0	0	0	0
-68	0	0	0	0	0	0	0	0	0	0	1	0
-65	0	0	0	0	0	2	0	0	0	0	28	0
-62	0	0	0	0	8	1	0	0	0	0	82	0
-59	0	0	0	0	75	3	0	0	0	0	50	0
-56	0	0	0	3	84	8	0	0	0	0	10	0
-53	0	0	0	33	7	36	0	0	0	0	2	0
-50	0	0	0	84	0	53	0	0	0	0	0	0
-47	0	0	0	42	0	36	0	0	0	1	0	0
-44	0	0	0	12	0	24	0	0	0	11	0	69
-41	0	0	0	0	0	7	0	0	0	45	0	91
-38	0	0	0	0	0	3	0	0	0	45	0	13
-35	0	0	0	0	0	0	0	0	0	50	0	1
-32	0	0	0	0	0	0	0	0	0	20	0	0
-29	0	0	0	0	0	0	0	0	0	1	0	0
-26	0	0	0	0	0	0	0	0	0	0	0	0
-23	0	0	0	0	0	0	0	0	0	0	0	0
-20	0	1	25	0	0	0	0	0	0	0	0	0
-17	0	3	97	0	0	0	0	0	0	0	0	0
-14	0	30	42	0	0	0	0	0	0	0	0	0
-11	3	82	10	0	0	0	0	0	25	0	0	0
- 8	15	51	0	0	0	0	0	0	83	0	0	0
- 5	83	6	0	0	0	0	0	1	47	0	0	0
- 2	54	1	0	0	0	0	0	59	17	0	0	0
+ 1	18	0	0	0	0	0	2	74	1	0	0	0
+ 4	0	0	0	0	0	0	71	29	0	0	0	0
+ 7	0	0	0	0	0	0	55	4	0	0	0	0
+10	0	0	0	0	0	0	37	5	0	0	0	0
+13	0	0	0	0	0	0	6	0	0	0	0	0
+16	0	0	0	0	0	0	0	0	0	0	0	0
+19	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
+25	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
+31	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
+37	0	0	0	0	0	0	0	0	0	0	0	0

of each parameter was then examined. The frequency distribution and summations of actual data, their squares, and cubes were calculated and stored for later processing along with the data in histogram form. The summation means were calculated using the equation:

UNGROUPED

$$\overline{X}_P = \frac{\sum_{1}^{N} X}{N}$$

where N = number of observations

$\overline{X}_P$ = the ungrouped mean

GROUPED

$$\overline{X}_G = \frac{\sum_{1}^{N} f\ X_g}{\sum_{1}^{N} f}$$

where X_g = internal mid-point

f = interval frequency

$\overline{X}_G$ = grouped mean

N = number of intervals

The standard deviation of the grouped and ungrouped data were calculated using the equations:

UNGROUPED

$$\sigma_{X_P} = \left(\frac{\Sigma\ X_P^2}{N - 1} - \frac{(\Sigma\ X_P)^2}{N(N - 1)}\right)^{\frac{1}{2}}$$

where σ_{X_P} = the ungrouped standard deviation

GROUPED

$$\sigma_{X_G} = \left(\frac{\Sigma f\ X_g^2}{N - 1} - \frac{(\Sigma f\ X_g)^2}{N(N - 1)}\right)^{\frac{1}{2}}$$

where σ_{X_G} = the grouped standard deviation

To test whether the statistical parameters obtained by the ungrouped and grouped method were significantly different, t and χ^2 tests were used[1].

The t test was used to test the hypothesis that $\overline{X}_P = \overline{X}_G$; the χ^2 test was used to test the hypothesis that $\sigma_{X_P} = \sigma_{X_G}$. Both were conducted at the 1% level. The equations involved are:

$$t = \frac{\overline{X}_G - \overline{X}_P}{\hat{\sigma}_{X_G}}$$

where $\hat{\sigma}_{\overline{X}_G} = \frac{\sigma_{X_G}}{\sqrt{N}}$

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[1] Croxton, Fredrick E. and Cowden, Dudley J.: Applied General Statistics, Second Edition, Prentice-Hall, 1959.

$$\chi^2 = \frac{n\,\sigma_{X_G}^2}{\sigma_{X_P}^2}$$

where $n = N - 1$

Table 4-1. Grouped vs Ungrouped Data (40 class intervals)

D-VALUE (meters) POR: 8 yrs

January 00Z (NHA)

Point No.	MEAN		STND DEVIATION		SKEWNESS	
	Ungrouped	Grouped	Ungrouped	Grouped	Ungrouped	Grouped
			1000 mb			
2	-20.0262	-21.2882	93.9216	96.9795	0.0068	0.0277
4	4.7293	5.5677	79.5919	81.8113	0.1013	0.1725
6	19.6812	20.6332	83.4759	85.4717	0.1003	0.1705
8	23.5028	23.6900	75.1602	76.3650	0.1918	0.2318
10	33.5546	33.2969	62.9044	62.4512	0.2091	0.2421
			850 mb			
2	-52.2899	-50.4202	87.1014	89.3886	0.0234	0.0199
4	-32.0126	-28.1513	60.8289	63.1500	0.0327	0.0337
6	-46.1008	-42.8571	59.8015	61.6786	0.0926	0.1049
8	-27.1765	-24.1597	57.7508	60.4076	0.3937	0.5430
10	27.3908	31.0924	55.5781	55.4485	0.0484	0.0418
			700 mb			
2	-96.9874	-96.7573	107.2528	111.5562	0.0048	0.0014
4	-92.0628	-91.1088	75.8698	79.4011	0.0169	0.0146
6	-105.2887	104.7071	67.7910	72.4447	0.0036	0.0119
8	-69.3807	-69.9791	75.9278	78.8301	0.0244	0.0179
10	21.4226	20.6067	77.7391	79.0672	0.1722	0.1118
			300 mb			
2	-248.3766	-246.1297	227.4802	229.5483	0.0	0.0003
4	-275.7824	-274.7908	201.6693	204.2869	0.0459	0.0495
6	-271.8912	-269.5607	186.7419	188.8480	0.0032	0.0007
8	-160.1925	-158.2636	175.3867	178.6745	0.0128	0.0129
10	76.9540	78.3473	168.1632	168.4372	0.3947	0.4098
			100 mb			
2	-193.6946	-188.8075	151.6525	152.9738	0.0270	0.0245
4	-247.4268	-242.5732	148.6051	152.2409	0.0457	0.0219
6	-252.8452	-247.3849	141.6453	146.7110	0.2000	0.1344
8	-169.7113	-164.7489	125.1353	125.9816	0.0847	0.0554
10	2.9121	8.6820	113.4603	114.9782	0.3399	0.4679
			10 mb			
2	-271.5991	-269.4934	356.5975	356.6723	0.0032	0.0031
4	-379.3362	-378.6638	387.4059	390.0792	0.5220	0.4829
6	-446.4202	-444.9580	396.8083	397.5807	0.9270	0.9384
8	-408.5002	-405.4622	356.4816	358.4227	1.2438	1.1981
10	-302.6681	-301.0504	306.9961	307.5251	1.9326	1.8615

Table 4-2. Grouped vs Ungrouped Data (40 class intervals)

TEMPERATURE (Degrees Centigrade) POR: 8 yrs

January 00Z (NHA)

1000 mb

Point No.	MEAN		STND DEVIATION		SKEWNESS	
	Ungrouped	Grouped	Ungrouped	Grouped	Ungrouped	Grouped
2	1.0349	1.0000	4.5382	4.5306	0.3421	0.4336
4	-10.7118	-10.6856	9.9059	9.9489	0.0136	0.0131
6	-12.1310	-12.1004	8.4397	8.5667	0.0008	0.0006
8	-4.4629	-4.5022	7.1632	7.1516	0.0536	0.0615
10	4.5939	4.6550	5.7891	5.8301	0.0011	0.0052
			850 mb			
2	-4.5401	-4.5317	4.9842	5.1565	0.0207	0.0391
4	-7.3319	-7.3698	10.7693	10.7400	0.2489	0.2633
6	-8.5798	-8.5240	9.3077	9.3034	0.0070	0.0084
8	-5.6681	-5.6681	8.1154	8.1595	0.0579	0.0625
10	1.3908	1.4412	6.1742	6.2476	0.7985	0.8848
			700 mb			
2	-12.0462	-12.0840	5.5971	5.5970	0.0030	0.0059
4	-12.7689	-12.7017	6.9222	7.0650	0.0007	0.0009
6	-12.9790	-13.0672	7.1797	7.1679	0.0136	0.0071
8	-10.3445	-10.3571	6.7072	6.6999	0.1352	0.1320
10	-3.7017	-3.7269	5.1113	5.1119	1.2876	1.1181
			300 mb			
2	-49.3277	-49.3193	3.4178	3.4517	0.0650	0.0465
4	-51.3025	-51.3487	3.9105	3.9501	0.1588	0.1122
6	-50.9118	-50.7563	3.3872	3.4689	0.0012	0.0018
8	-48.2059	-48.0840	3.1775	3.2429	0.0021	0.0024
10	-43.9160	-43.8740	3.4152	3.4837	0.1009	0.0763
			100 mb			
2	-53.6913	-53.5798	4.4485	4.4142	0.0733	0.0768
4	-54.7689	-54.7899	4.1462	4.1671	0.3529	0.2315
6	-55.7605	-55.7857	3.6360	3.6860	0.5222	0.5446
8	-58.3908	-58.3193	3.1507	3.2477	0.0531	0.0673
10	-64.0420	-64.0546	3.5576	3.6320	0.1337	0.1133
			10 mb			
2	-53.5294	-53.5294	7.7032	7.8011	0.0387	0.0178
4	-55.2521	-55.3445	6.9035	6.9409	0.0319	0.0431
6	-55.5000	-55.5084	6.0342	6.0523	0.0014	0.0007
8	-53.2101	-53.1891	4.8953	4.9455	0.0177	0.0203
10	-50.2899	-50.3529	3.8259	3.8813	0.1638	0.1753

To test whether the distributions being collected were significantly skewed, a coefficient of skewness was calculated and used to make a B_1 test. The tests were made at the 2% significance level. A sample output of means, standard deviations, and skewness for January are given in Tables 4-1 through 4-4.

Table 4-3. Grouped vs Ungrouped Data (40 class intervals)

WIND U-COMPONENT (Meters Per Second) POR: 3 yrs

January 00Z (NHA)

Point No.	MEAN		STND DEVIATION		SKEWNESS	
	Ungrouped	Grouped	Ungrouped	Grouped	Ungrouped	Grouped
			1000 mb			
2	2.8587	2.7609	10.9631	10.9814	0.1529	0.1236
4	1.6304	1.5870	10.0970	9.9401	0.0158	0.0022
6	1.5000	1.5870	7.1721	7.2622	0.0217	0.0125
8	5.1413	5.2826	7.8999	7.9419	0.1931	0.1332
10	1.6956	1.6739	6.6477	6.7329	0.1021	0.1119
			850 mb			
2	4.9239	4.8478	8.1000	8.0061	0.0044	0.0064
4	8.8044	8.8044	6.7110	6.8800	0.0173	0.0079
6	6.0435	6.0652	5.4529	5.4537	0.0807	0.0708
8	9.9783	10.0217	7.1759	7.2438	0.0021	0.0053
10	8.7935	8.5000	6.2889	6.3765	0.0001	0.0232
			700 mb			
2	10.5484	10.4032	11.0577	11.0198	0.0278	0.0384
4	12.9677	12.9839	7.7086	7.8514	0.0111	0.0335
6	12.0323	12.1667	6.6159	6.6551	0.0908	0.0465
8	15.6559	15.5645	8.0521	8.2696	0.1962	0.3490
10	17.6452	17.5430	7.6110	7.6555	0.0926	0.1240
			300 mb			
2	27.1290	27.1344	22.0987	22.0847	0.0652	0.0623
4	27.5807	27.6075	19.0573	19.0157	0.0574	0.0740
6	26.7742	26.8333	18.1354	18.3430	0.2523	0.2438
8	41.3871	41.3280	21.3318	21.3616	0.0058	0.0051
10	41.4086	41.5430	16.1078	16.2427	0.0049	0.0188
			100 mb			
2	15.5591	15.5215	9.8350	9.8444	0.5159	0.5462
4	18.6989	18.7903	11.0854	11.1302	0.1821	0.1415
6	21.8925	21.9731	9.5922	9.6882	0.0387	0.0744
8	28.3763	28.2957	10.6485	10.7264	0.0767	0.1008
10	32.3871	32.2097	10.3231	10.2668	0.3065	0.3717
			10 mb			
2	0.2935	0.3261	16.2139	16.1481	0.3677	0.3772
4	7.0870	7.1956	18.3738	18.5376	0.1794	0.1571
6	14.5652	14.7174	20.2541	20.2120	0.0929	0.0975
8	15.6196	15.6739	17.7057	17.8828	0.0233	0.0222
10	12.6196	12.7174	16.0869	16.1775	0.2284	0.2340

Some conclusions can be made as a result of these tests. One, the data can be used to calculate the mean and standard deviation of the data if the class intervals are chosen to reflect the range. Two, there are some distributions that are skewed significantly which indicate the histogram or actual distribu-

Table 4-4. Grouped vs Ungrouped Data (40 class intervals)

WIND V-COMPONENT (Meters Per Second) POR: 3 yrs

January 00Z (NHA)

Point No.	MEAN		STND DEVIATION		SKEWNESS	
	Ungrouped	Grouped	Ungrouped	Grouped	Ungrouped	Grouped
			1000 mb			
2	3.2391	3.1522	9.2491	9.3602	0.0020	0.0004
4	-1.4783	-1.4130	7.0125	7.0441	0.3941	0.4707
6	0.3043	0.2826	8.6122	8.4643	0.0054	0.0068
8	-0.1522	-0.2391	8.1873	8.2019	0.0068	0.0011
10	-0.5435	-0.5435	7.5860	7.6516	0.0002	0.0001
			850 mb			
2	4.2717	4.2391	8.0549	8.3217	0.2428	0.2789
4	-0.0109	-0.0217	6.0610	6.1866	0.0032	0.0008
6	-4.8913	-4.8478	7.7806	7.8031	0.0095	0.0000
8	-0.9674	-1.1522	8.0526	7.8509	0.5722	0.6868
10	0.5978	0.5435	7.6159	7.7855	0.2489	0.3184
			700 mb			
2	1.9893	2.0161	10.7940	10.9103	0.0307	0.0081
4	-5.2796	-5.1237	6.3885	6.1994	0.0918	0.1202
6	-7.7527	-7.7903	7.9532	0.0468	0.2065	0.1783
8	-2.4193	-2.3280	8.9665	9.0585	0.0600	0.0720
10	-0.6882	-0.6075	8.6552	8.4564	0.1729	0.1498
			300 mb			
2	-6.6989	-6.8441	23.1060	22.9908	0.0021	0.0008
4	-13.4839	-13.4247	19.4140	19.2840	0.0453	0.0365
6	-11.3548	-11.5323	19.8793	19.9120	0.2333	0.1958
8	-0.4301	-0.3495	23.7053	23.4840	0.0409	0.0417
10	2.1505	2.1021	17.2557	17.3951	0.0412	0.0507
			100 mb			
2	7.5376	-7.6183	9.3861	9.4614	0.3973	0.2264
4	-9.8172	-9.6828	9.4948	9.4833	0.1801	0.1283
6	-7.2150	-7.2742	10.2616	10.2873	1.6258	1.5791
8	-1.4624	-1.5968	9.6690	9.7825	0.0498	0.0422
10	0.6882	0.6398	8.0095	7.9531	0.1029	0.0898
			10 mb			
2	-13.7609	-13.8044	12.8699	12.8506	0.8748	0.8206
4	-16.8696	-16.7174	11.8184	11.8060	0.0745	0.1215
6	-12.4348	-12.5870	12.9167	13.0255	0.5185	0.4643
8	-6.0109	-5.9348	13.1680	13.3469	0.0172	0.0168
10	-1.7826	-1.9787	10.1817	10.3089	0.0246	0.0352

tion should be used for statistical limits. Three, despite the much shorter period of record in some cases, the significance level of the tests used are designed for sample size. Confidence limits of the parameters would be rather

broad but, in general, the range would narrow as the period of record increases.

Examination of the original 40-interval histograms indicated a packing of D-values in the high positive intervals in low latitudes at high altitudes in the summer. The distributions also showed packing of D-values in the large negative intervals in high latitudes at high altitudes in winter. The U- and V-component fields appeared to be within the original limits. The temperature at high latitudes and high altitudes also showed a grouping of the values in the large negative intervals. In order to preserve the one histogram per parameter concept, the range, interval size, and interval range had to be adjusted to account for frequency distributions with large positive and large negative means. Adjustment of the interval size to accommodate extreme means reduced the required intervals for each parameter from 40 to 32. The interval size for each parameter was changed as follows: Temperature from 3 to 4°C; D-values from 50 to 120 m; and U and V components from 4 to 5 m/sec. The examination of representative samples of the analyses showed a high rate of consistency from analysis to analysis (greater than 99%). In the isolated cases where questionable data were present, the value was so far removed from the actual distribution of the parameter that including it with the rest of the data would give means and standard deviations that would be meaningless. Intervals 1 and 32 were open-ended to accept any value for any parameter. Examination of these histograms can be made at various stages of production to discover whether bad data exist, and bad data will be flagged as questionable in the data base described in Appendix B. All tables in Appendix C that contain means, standard deviations, and skewness contain all available data and no attempt was made to remove that data considered bad. All data entries in Appendix C that do contain bad data are marked with an asterisk.

This portion of the feasibility study shows that grouping of the data is valuable in quality-controlling the input. The grouping is also valuable to compute the mean and standard deviation of the distribution if the class intervals are chosen to reflect the range. The constant interval size in this study would make the standard deviation larger than the ungrouped standard deviation in areas of low parameter variability over the period of record. Examples of this would be the Tropical Weather Analyses where the D-value and temperature are contained in only two intervals.

Station Data Versus Analysis Data

The preceding portion of this study indicated that grouping of the data was used mainly as a quality control technique. It also disclosed that parameters in areas of wide variability would be grouped and standard statistics

Table 5. List of Stations and I,J, Grid Points Used in the Study (Period of Record of each is included).

No	Station Name	WMO #	Lat (Deg)	Long (Deg)	POR Yrs	Begin End	I , J	Lat (Deg)	Long (Deg)	Begin	POR
1	Sapporo, Japan	47412	4303N	1412E	10	Jan 56-Dec 65	16,16	4301N	14108E	Aug70-	3
2	Beirut, Lebanon	40100	3349N	3529E	9	Jan 57-Apr 60 Jan 61-Apr 61 May 62-Jun 67	39,19	3402N	3500E	Aug70-	3
3	Athens, Greece	16716	3754N	2344E	17	Jun 50-Nov 50 Apr 51-Jan 56 Mar 56-Aug 67	39,23	3709N	2101E	Aug70-	3
4	Adak, Alaska	70454	5135N	1763W	17	Jan 46-Mar 46 Feb 47-Jun 50 Jan 51-Feb 64 Jun 70	13,25	5101N	17501W	Aug70-	3
5	Thule, Greenland	04202	7632N	6345W	4	Aug 52-Sep 56	25,30	7500N	6509W	Aug70-	3
6	Perth, Australia	94610	3156S	11558E	8	Jan 50-Dec 57	19,43	3008S	11603E	Aug71-	2
7	Capetown, S. Africa	68816	3358S	1836E	14	Jan 65-Dec 67 Jul 49-Dec 60	41,29	3202S	2000E	Aug71-	2
8	Auckland, N. Zealand	93119	3651S	17447E	8	Jul 49-Jul 53 Sep 53-Aug 57	9,30	4307S	17500E	Aug71-	2
9	Commandante Espora, Argentina	87748	3844S	6210W	4	Jan 63-Aug 63 Nov 63-Sep 65 Dec 65-Dec 67	29,12	3901S	6003W	Aug71-	2
10	Cape Hallett, Antarctica	87701	7218S	1701E	5	Feb 57-Nov 61 Jan 62-Sep 62	19,28	7004S	16800E	Aug71-	2
11	Guam, Marianas I.	91218	1335N	14455E	6	Jul 50-Sep 56	44,07	1408N	14500E	Aug70-	3
12	Sao Paulo, Brazil	83783	2331S	4637W	4	Feb 55-Feb 59	10,15	2402S	4500W	Aug70-	3
13	Balboa, CZ	78807	0858N	7933W	18	Feb 49-Jun 49 Aug 49-Dec 64	17, 8	0909N	8000W	Aug70-	3
14	Darwin, Australia	94120	1226S	13053E	15	May 43-Oct 43 Dec 43-Jan 46 Mar 46-Jul 47 Sep 47-Dec 58	47,12	0909S	13000E	Aug70-	3
15	Pretoria, S. Africa	68262	2544S	2811E	13	Jan 49-Dec 53 Jan 56-Dec 60 Jan 65-Dec 67	67,15	2402S	3000E	Aug70-	3

computed from these grouped data. In this portion of the study, the following major areas will be explored:

- Scope of the station comparisons.
- Comparisons of the four parameters at all available levels and in all forms for January and July.
- Limitations of the comparisons between the station and analysis data.

Scope of the Station Comparisons

Five grid points near radiosonde stations were selected from each of the NHA, SHA, and TWA for a total of 15 points (Table 5). The stations chosen ranged from Thule AB to Beirut in the NHA, from Guam to Pretoria in the TWA, and from Capetown to Cape Hallett in the SHA. These stations were chosen because of their availability and, at the same time, an attempt was made to choose representative samplings of the three analysis projections. The location of the stations on their respective projections were previously shown in Figures 1a,b,c.

The adjustment in the interval size and interval number explained earlier is compatible with normally-analyzed intervals for each parameter (5 m/sec for wind components, 120 meters for D-values, and 4° for temperature). The new interval mid-points for each parameter are given in Table 6.

Table 6. Interval Mid-point Values (32 Intervals).

Interval #	U & V Component (m/sec)	D-Value (m)	Temperature (°C)
1	-58	-2700	-90.5
2	-53	-2580	-86.5
3	-48	-2460	-82.5
4	-43	-2340	-78.5
5	-38	-2220	-74.5
6	-33	-2100	-70.5
7	-28	-1980	-66.5
8	-23	-1860	-62.5
9	-18	-1740	-58.5
10	-13	-1620	-54.5
11	-08	-1500	-50.5
12	-03	-1380	-46.5
13	02	-1260	-42.5
14	07	-1140	-38.5
15	12	-1020	-34.5
16	17	-900	-30.5
17	22	-780	-26.5
18	27	-660	-22.5
19	32	-540	-18.5
20	37	-420	-14.5
21	42	-300	-10.5
22	47	-180	-6.5
23	52	-60	-2.5
24	57	60	1.5
25	62	180	5.5
26	67	300	9.5
27	72	420	13.5
28	77	540	17.5
29	82	660	21.5
30	87	780	25.5
31	92	900	29.5
32	97	1020	33.5

Data Form Comparisons

Table 7 is a grouping of information concerning the 4 parameters being evaluated. Information is included for one station in each of the three analyses. Cape Hallett is included for the Southern Hemisphere, Albrook AFB for the Tropics, and Beirut for the Northern Hemisphere. The information for each sample location is contained on 8 pages. The first page contains information of the D-value and temperature parameters (January) with the facing page (second page) showing the maximum differences in the means and standard deviations taken from the preceding data. The third and fourth pages contain the same information concerning the U- and V-Wind Components (January). The fifth and sixth pages have the statistics for the D-Value and temperature for July while the July information for the U- and V-Wind Components is found on the seventh and eighth pages. The first eight pages of Table 7 concern Beirut (NHA), the second eight pages concern Albrook AFB (TWA), and the last eight pages cover Hallett (SHA). The data included for each parameter are as follows: ungrouped 00Z, ungrouped 12Z, ungrouped 00Z and 12Z combined, station, grouped 00Z and 12Z combined.

Table 7-1. Values of Specified Parameters at Various Pressure Levels.

STATION: BEIRUT, LEBANON (Northern Hemisphere) MONTH: JANUARY

D-VALUE (METERS)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Combined Standard Deviation
1000 mb	46.28	37.43	41.88	33.00	45.43	40.83	42.58	41.82	42.80	50.49
850 mb	46.25	45.40	45.83	41.00	44.14	43.32	43.89	43.48	41.20	49.94
700 mb	46.58	46.79	46.68	34.00	44.83	62.67	61.20	61.77	49.50	65.29
500 mb	54.68	57.16	55.91	41.00	60.00	89.05	90.00	89.27	78.90	96.83
400 mb	51.53	54.71	53.10	39.00	53.79	115.10	113.91	114.19	97.50	112.68
300 mb	35.53	37.07	36.29	28.00	36.55	135.48	131.01	132.91	119.40	132.64
250 mb	25.15	24.57	24.86		21.38	140.79	140.45	140.21		140.74
200 mb	30.09	30.01	30.05	32.00	25.52	125.31	120.82	122.76	120.70	126.95
150 mb	22.66	28.51	25.55	38.00	24.14	108.59	105.79	106.94	108.40	113.39
100 mb	-25.52	-23.97	-24.75	0.00	-26.21	93.03	94.67	93.57	94.80	102.09
70 mb	-95.26	-86.76	-91.04	-61.00	-89.13	87.45	96.01	91.64	83.20	104.25
50 mb	-164.91	-157.16	-161.06	-112.00	-162.66	89.15	91.58	90.19	77.60	96.57
30 mb	-253.59	-253.16	-253.38	-177.00	-255.61	108.26	111.43	109.53	76.90	120.11
20 mb	-331.76	-328.47	-330.11	-131.00	-325.81	141.90	138.96	140.04	-	141.88
10 mb	-125.10*	-142.77*	-133.88*		-134.91*	409.85*	390.47*	399.27*		397.64*

TEMPERATURE (DEGREES CENTIGRADE)

1000 mb	7.90	13.08	10.47	15.70	10.49	3.19	3.33	4.16	3.28	4.23
850 mb	4.59	4.81	4.70	4.20	4.63	4.29	4.10	4.18	3.65	4.36
700 mb	-3.93	-3.98	-3.95	-4.70	-4.02	3.88	3.92	3.89	3.64	4.11
500 mb	-20.91	-20.73	-20.82	-21.00	-20.95	3.55	3.51	3.52	3.66	3.75
400 mb	-32.66	-32.54	-32.60	-32.70	-32.64	3.24	3.41	3.32	3.61	3.38
300 mb	-46.72	-46.71	-46.71	-46.10	-46.78	2.89	2.84	2.86	3.06	3.15
250 mb	-52.96	-126.91*	-89.51*		-53.17	3.23	686.48*	482.62*		4.46*
200 mb	-55.80	-55.94	-55.87	-55.60	-55.81	4.93	4.85	4.88	4.38	4.98
150 mb	-58.19	-57.98	-58.09	-57.80	-58.11	3.47	3.42	3.44	3.57	3.54
100 mb	-62.43	-63.20	-62.81	-62.10	-62.73	2.52	2.29	2.43	3.64	2.53
70 mb	-62.76	-63.80	-63.28	-61.80	-63.31	1.95	2.47	2.28	2.70	2.66
50 mb	-61.37	-62.73	-62.05	-61.60	-61.99	2.37	2.97	2.76	3.45	3.04
30 mb	-58.10	-58.87	-58.49	-59.00	-58.66	3.31	4.62	4.02	4.85	4.19
20 mb	-54.48	-55.02	-54.75	-52.00	-54.85	3.94	4.83	4.40		4.62
10 mb	-49.45	-48.83	-49.14		-49.25	3.62	4.35	4.00		4.08

Table 7-2. Maximum Differences in Means and Standard Deviations.

STATION: BEIRUT, LEBANON MONTH: JANUARY

Number of Analysis Observations: 00Z 87 12Z 86

	D-Values		Temperature	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	8.9	meters	-5.1	degrees K
	1000	mb	1000	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	-8.5	meters	-0.9	degrees K
	70	mb	20	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	199.1	meters	5.2	degrees K
	20	mb	1000	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	-32.6	meters	1.2	degrees K
	30	mb	100	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	194.8	meters	5.2	degrees K
	20	mb	1000	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	-43.2	meters	1.1	degrees K
	30	mb	100	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	4.6	meters	.2	degrees K
	200	mb	30	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-12.7	meters	-.4	degrees K
	70	mb	70	mb
Number of Pressure Levels Available at Station	13	levels	13	levels

Table 7-3. Values of Specified Parameters at Various Pressure Levels.

STATION: BEIRUT, LEBANON (Northern Hemisphere) MONTH: January

WIND U-COMPONENT (METERS/SEC)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb	- 3.26	- 3.66	- 3.46	1.59	- 3.38	4.77	4.60	4.68	3.38	4.75
850 mb	1.28	1.08	1.18	3.69	1.48	4.79	4.47	4.67	3.91	4.82
700 mb	5.43	4.72	5.08	8.08	5.13	6.00	5.52	5.77	4.98	5.84
500 mb	12.19	12.15	12.17	15.26	12.11	8.76	8.55	8.63	7.49	8.84
400 mb	17.22	17.46	17.34	21.13	17.40	11.73	11.34	11.51	10.03	11.71
300 mb	24.68	26.19	25.43	27.56	25.56	14.68	16.72	15.69	12.19	15.59
250 mb	30.37	30.70	30.54		30.59	15.64	16.88	16.22		16.23
200 mb	35.58	35.64	35.60	35.30	35.47	16.69	15.83	16.22	11.53	16.41
150 mb	36.63	36.03	36.33	34.15	36.22	15.94	14.61	15.25	8.59	14.73
100 mb	29.20	27.04	28.13	27.31	27.89	11.59	10.11	10.91	8.82	10.90
70 mb	18.44	18.28	18.36	19.52	18.60	7.38	8.50	7.93	7.41	8.11
50 mb	13.69	12.18	12.94	14.53	12.98	7.36	9.10	8.28	6.77	8.54
30 mb	11.37	8.74	10.07		10.02	10.66	10.52	10.64		10.75
20 mb	13.11	10.76	11.94		12.00	14.67	13.72	14.21		14.24
10 mb	16.94	14.71	15.84		15.92	17.83	17.26	17.54		17.75

WIND V-COMPONENT (METERS/SEC)

1000 mb	3.13	3.36	3.25	2.31	3.19	4.68	4.65	4.65	4.27	4.92
850 mb	1.14	0.68	0.91	2.99	0.84	3.87	3.26	3.58	4.64	3.90
700 mb	0.89	0.97	0.93	1.53	0.99	6.51	5.25	5.90	6.46	6.15
500 mb	- 0.84	0.66	- 0.09	1.59	- 0.09	9.92	8.88	9.43	8.86	9.46
400 mb	- 1.63	0.36	- 0.64	1.65	- 0.61	11.41	11.38	11.41	11.83	11.50
300 mb	- 1.77	0.41	- 0.69	1.26	- 0.61	14.42	14.97	14.26	13.01	14.22
250 mb	- 1.86	0.52	- 0.68		- 0.55	15.48	14.07	14.81		14.64
200 mb	- 1.97	0.77	- 0.61	0.80	- 0.61	14.93	13.81	14.43	13.21	14.36
150 mb	- 1.19	0.72	- 0.24	1.62	- 0.12	11.85	11.20	11.34	11.52	11.75
100 mb	- 1.53	- 0.81	- 1.17	0.59	- 1.36	8.32	7.92	8.11	7.11	8.26
70 mb	0.05	- 1.31	- 0.62	1.73	- 0.63	5.79	5.68	5.76	6.69	5.92
50 mb	- 0.39	- 1.12	- 0.75	1.53	- 0.70	5.62	5.40	5.51	5.12	5.55
30 mb	1.00	0.01	0.51		0.51	7.79	6.38	7.12		7.23
20 mb	2.39	2.71	2.55		2.46	8.69	7.63	8.16		8.19
10 mb	2.18	2.37	2.79		2.29	8.54	9.37	8.93		8.93

Table 7-4. Maximum Differences in Means and Standard Deviations.

STATION: BEIRUT, LEBANON MONTH: JANUARY

Number of Analysis Observations: 00Z 87 12Z 84

	WIND U - COMPONENT		WIND V - COMPONENT	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	2.6	METERS/SEC	- 2.7	METERS/SEC
	30	mb	200	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	- 2.0	METERS/SEC	1.4	METERS/SEC
	300	mb	250	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	5.1	METERS/SEC	2.3	METERS/SEC
	1000	mb	50	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	- 6.7	METERS/SEC	- 1.3	METERS/SEC
	150	mb	300	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	5.0	METERS/SEC	2.2	METERS/SEC
	1000	mb	50	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	- 6.1	METERS/SEC	- 1.2	METERS/SEC
	150	mb	300	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	- 0.3	METERS/SEC	0.5	METERS/SEC
	850	mb	10	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	0.5	METERS/SEC	- 1.3	METERS/SEC
	150	mb	700	mb
Number of Pressure Levels Available at Station	11	levels	11	levels

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Table 7-5. Values of Specified Parameters at Various Pressure Levels.

STATION: BEIRUT, LEBANON (Northern Hemisphere) MONTH: JULY

D-VALUE (METERS)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb	- 57.27	- 55.63	- 56.44	- 47.00	- 56.44	19.61	19.79	19.66	19.61	0.01
850 mb	11.54	22.69	17.11	26.00	40.47	16.05	15.89	16.88	19.10	44.43
700 mb	98.33	110.45	104.36	113.00	98.15	24.32	24.68	25.17	27.60	56.04
500 mb	260.56	273.59	267.04	283.00	266.71	36.77	39.69	38.69	42.30	53.89
400 mb	369.64	389.45	379.55	398.00	377.44	51.15	53.72	53.23	52.80	60.43
300 mb	515.29	536.59	525.88	545.00	524.05	58.06	60.30	59.97	64.10	65.99
250 mb	604.60	629.77	617.11		614.22	60.87	59.95	61.54		68.97
200 mb	689.42	712.30	700.86	727.00	699.07	56.68	54.96	56.83	7280	67.29
150 mb	717.61	743.80	730.63	760.00	728.67	54.15	50.14	53.68	85.60	63.62
100 mb	605.72	621.98	613.50	634.00	610.06	48.74	43.98	47.06	84.80	59.32
70 mb	455.09	470.62	462.86	489.00	457.24	42.52	46.22	44.96	97.80	58.59
50 mb	358.32	362.64	360.48	399.00	362.07	42.26	47.17	44.70	88.80	64.16
30 mb	320.69	322.90	321.79	368.00	321.38	49.18	62.72	56.21	102.60	66.72
20 mb	316.91	316.38	316.64	364.00	316.55	57.77	73.79	66.08	146.70	74.51
10 mb	639.95*	655.83*	647.89*		644.83*	451.72*	447.24*	448.26*		445.58*
				TEMPERATURE (DEGREES CENTIGRADE)						
1000 mb	21.98	28.94	25.48	27.26	25.48	1.23	1.59	3.77	1.33	4.06
850 mb	19.13	19.47	19.30	19.67	19.29	3.03	2.68	2.86	3.02	3.01
700 mb	10.79	10.79	10.79	11.46	11.05	2.23	2.21	2.21	2.53	2.46
500 mb	- 4.72	- 4.20	- 4.46	- 3.83	- 4.44	2.73	2.54	2.65	2.71	2.88
400 mb	-14.76	-14.13	-14.44	-14.20	-14.38	2.69	2.63	2.67	2.73	2.82
300 mb	-27.48	-27.38	-27.43	-27.56	-27.47	1.76	1.56	1.66	2.23	1.66
250 mb	-36.10	-36.05	-36.08		-36.19	1.89	1.67	1.78		2.16
200 mb	-46.72	-46.61	-46.66	-47.14	-46.41	1.75	1.59	1.67	2.36	1.88
150 mb	-59.13	-59.01	-59.07	-59.64	-59.01	1.85	1.96	1.90	2.43	2.23
100 mb	-70.93	-72.79	-71.86	-72.41	-71.96	1.75	1.90	2.05	2.56	2.24
70 mb	-68.58	-70.23	-69.40	-70.34	-69.42	2.56	3.15	2.98	5.92	3.22
50 mb	-60.37	-61.78	-61.08	-62.68	-61.17	1.75	2.99	2.54	5.42	2.96
30 mb	-52.71	-54.46	-53.59	-56.00	-53-58	1.60	3.14	2.64	3.03	2.90
20 mb	-47.54	-49.37	-48.45	-53.07	-48.48	1.66	3.46	2.86	4.07	3.15
10 mb	-41.43	-41.09	-41.26		-41.54	1.40	2.45	2.00		2.47

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Table 7-6. Maximum Differences in Means and Standard Deviations.

STATION: BEIRUT, LEBANON MONTH: JULY

Number of Analysis Observations: 00Z 85 12Z 86

	D-Values		Temperature	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	-26.2	meters	-7.0	degrees K
	150	mb	1000	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	-16.0	meters	-1.8	degrees K
	20	mb	20	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	47.4	meters	-4.6	degrees K
	20	mb	20	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	80.7	meters	3.0	degrees K
	20	mb	70	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	47.5	meters	-4.6	degrees K
	20	mb	20	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	72.2	meters	2.7	degrees K
	20	mb	70	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	-23.3	meters	-0.3	degrees K
	850	mb	200	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-30.9	meters	-0.5	degrees K
	700	mb	10	mb
Number of Pressure Levels Available at Station	13 levels		13 levels	

Table 7-7. Values of Specified Parameters at Various Pressure Levels.

STATION: BEIRUT, LEBANON (Northern Hemisphere) MONTH: JULY

WIND U-COMPONENT (METERS/SEC)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb	2.94	2.55	2.75	5.09	2.86	2.80	2.92	2.86	1.83	3.25
850 mb	5.05	3.89	4.47	1.67	4.35	2.94	2.46	2.77	2.05	3.21
700 mb	3.98	4.79	4.38	3.65	4.34	3.94	3.21	3.61	3.68	3.94
500 mb	9.01	8.46	8.74	8.69	8.79	5.76	5.43	5.59	5.67	5.70
400 mb	11.75	11.52	11.64	12.39	11.68	6.77	7.97	7.37	7.32	7.62
300 mb	15.10	14.65	14.78	10.03	14.71	8.96	9.47	9.20	9.09	9.28
250 mb	15.17	13.91	14.54		14.54	9.21	9.50	9.35		9.51
200 mb	14.86	13.59	14.22	24.16	14.26	10.21	9.87	10.03	12.77	10.09
150 mb	12.64	11.31	11.97	23.63	12.00	9.77	9.59	9.68	9.76	9.79
100 mb	5.39	2.88	4.14	4.97	4.19	9.16	9.39	9.33	7.65	9.35
70 mb	- 3.74	- 4.81	- 4.28	- 4.22	- 4.43	5.56	5.73	5.66	6.13	5.93
50 mb	- 9.54	-11.32	-10.43	- 9.06	-10.44	5.11	5.41	5.32	6.23	5.55
30 mb	-14.09	-13.81	-13.95	-11.37	-13.94	5.62	6.54	6.08	5.57	6.18
20 mb	-14.28	-14.66	-14.47		-14.69	7.17	8.51	7.85		8.19
10 mb	-16.67	-19.85	-18.26		-18.20	8.39	7.93	8.29		8.31

WIND V-COMPONENT (METERS/SEC)

1000 mb	- 5.83	- 6.79	- 6.31	2.65	- 6.06	2.93	3.27	3.13	3.40	3.79
850 mb	- 2.07	- 0.57	- 1.32	- 0.33	- 1.40	3.19	2.60	3.00	3.45	3.36
700 mb	- 0.21	- 0.15	- 0.18	- 0.25	- 0.13	4.01	3.81	3.90	4.50	4.31
500 mb	2.20	3.25	2.72	2.59	2.75	5.89	5.05	5.49	6.19	5.70
400 mb	4.11	4.91	4.51	5.03	4.42	7.71	6.71	7.22	7.46	7.22
300 mb	8.41	8.32	8.37	6.60	8.44	9.84	9.10	9.45	7.56	9.58
250 mb	10.13	9.17	9.65		9.80	11.82	10.65	11.23		11.32
200 mb	11.58	9.76	10.67	- 2.45	10.77	10.98	10.72	10.86	9.62	10.82
150 mb	11.83	11.07	11.45	- 1.18	11.36	9.83	8.92	9.37	8.41	9.46
100 mb	10.65	10.00	10.32	9.57	10.38	8.37	6.58	7.52	5.43	7.75
70 mb	5.33	5.44	5.39	6.10	5.33	4.33	4.15	4.23	5.07	4.41
50 mb	1.43	3.05	2.24	4.40	2.28	2.96	4.09	3.65	4.20	3.86
30 mb	0.87	0.92	0.89	1.15	1.13	3.35	4.41	3.90	7.84	3.92
20 mb	1.55	0.13	0.84		0.87	4.61	5.39	5.05		5.24
10 mb	3.05	0.75	1.90		1.82	4.91	4.93	5.04		5.23

Table 7-8. Maximum Differences in Means and Standard Deviations.

STATION: BEIRUT, LEBANON MONTH: JULY

Number of Analysis Observations: 00Z 87 12Z 86

	WIND U - COMPONENT	WIND V - COMPONENT
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	3.2 METERS/SEC	2.3 METERS/SEC
	10 mb	10 mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	- 1.3 METERS/SEC	1.8 METERS/SEC
	20 mb	100 mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	10.0 METERS/SEC	-13.1 METERS/SEC
	200 mb	200 mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	2.8 METERS/SEC	3.9 METERS/SEC
	200 mb	30 mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	9.9 METERS/SEC	-13.3 METERS/SEC
	200 mb	200 mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	2.7 METERS/SEC	3.9 METERS/SEC
	200 mb	30 mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	0.2 METERS/SEC	- 0.2 METERS/SEC
	20 mb	30 mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	- 0.4 METERS/SEC	- 0.7 METERS/SEC
	850 mb	1000 mb
Number of Pressure Levels Available at Station	12 levels	12 levels

Figure 7-9. Values of Specified Parameters at Various Pressure Levels.

STATION: ALBROOK AFB, CZ (Tropical) MONTH: JANUARY

D-VALUE (METERS)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd Dev
1000 mb				- 18.00					17.90	
850 mb	26.70	27.92	27.31	52.00	56.13	11.97	12.31	12.12	16.80	21.27
700 mb	99.11	97.64	98.37	128.00	80.90	20.77	21.08	20.87	18.30	45.66
500 mb	245.48	241.16	243.31	282.00	222.58	34.64	34.18	34.36	24.40	57.60
400 mb	343.92	338.94	341.41	386.00	326.32	45.97	44.59	45.20	30.70	49.82
300 mb	450.52	445.59	448.03	498.00	444.00	60.05	59.58	59.67	38.80	50.06
250 mb	503.76	498.89	501.31	554.00	504.39	67.34	67.65	67.32	44.00	92.93
200 mb	545.72	541.74	543.58	596.00	546.97	77.39	78.15	77.55	49.40	76.43
150 mb	504.71	504.43	504.57	565.00	501.29	86.89	87.23	86.78	53.20	98.55
100 mb	288.00	292.38	290.20	360.00	292.26	95.16	93.18	93.89	58.30	100.19
70 mb				119.00					63.10	
50 mb	- 93.03	- 84.25	-88.61	- 14.00	- 81.68	78.93	77.29	77.98	70.60	88.07
30 mb				-114.00					90.00	
20 mb				-155.00					110.10	
10 mb				-178.00					125.60	

TEMPERATURE (DEGREES CENTIGRADE)

1000 mb				25.58					2.53	
850 mb	17.09	16.78	16.93	16.77	17.10	1.14	1.07	1.12	1.37	1.20
700 mb	9.67	9.21	9.44	9.52	9.70	1.57	1.57	1.58	1.49	1.80
500 mb	- 4.94	- 4.94	- 4.94	- 5.47	- 5.10	1.47	1.43	1.45	1.69	1.90
400 mb	-16.84	-16.83	-16.83	-16.82	-17.10	2.00	2.08	2.03	1.69	2.30
300 mb	-32.72	-32.88	-32.80	-33.08	-32.90	1.90	1.84	1.86	1.60	2.10
250 mb	-42.77	-42.80	-42.79	-43.03	-42.90	1.65	1.72	1.68	1.50	2.20
200 mb	-54.36	-54.28	-54.32	-54.28	-54.40	1.90	2.15	2.02	1.58	2.30
150 mb	-67.26	-66.43	-66.84	-66.70	-66.80	1.60	1.61	1.66	1.61	1.90
100 mb	-81.09	-80.80	-80.94	-79.81	-80.90	1.71	1.92	1.82	2.39	2.10
70 mb				-75.06					2.76	
50 mb	-67.03	-66.80	-66.92	-65.63	-66.90	3.21	3.32	3.25	2.66	3.50
30 mb				-56.99					2.92	
20 mb				-51.82					3.14	
10 mb				-44.32					3.11	

Table 7-10. Maximum Differences in Means and Standard Deviations.

STATION: ALBROOK AFB, CZ (Tropical) MONTH: JANUARY

Number of Analysis Observations: 00Z 77 12Z 78

	D-Values		Temperature	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	- 8.7	meters	- 0.9	degrees K
	50	mb	150	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	2.0	meters	- 0.3	degrees K
	100	mb	200	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	74.6	meters	1.3	degrees K
	50	mb	50	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	-35.6	meters	0.6	degrees K
	100	mb	100	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	67.6	meters	1.3	degrees K
	50	mb	50	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	-45.4	meters	- 0.8	degrees K
	150	mb	50	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	20.8	meters	0.3	degrees K
	500	mb	400	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-25.6	meters	- 0.5	degrees K
	250	mb	250	mb
Number of Pressure Levels Available at Station	15	levels	15	levels

Table 7-11. Values of Specified Parameters at Various Pressure Levels.

STATION: ALBROOK AFB, CZ (Tropical) MONTH: JANUARY

WIND U-COMPONENT (METERS/SEC)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb	-	-	-	0.747	-	-	-	-	1.39	-
850 mb	-3.89	-4.64	-4.27	-1.510	-4.10	3.29	3.54	3.43	3.17	3.55
700 mb	-3.36	-3.46	-3.41	-2.016	-3.65	3.42	3.36	3.38	3.38	3.78
500 mb	-4.23	-3.42	-3.82	-2.502	-3.81	6.75	6.89	6.81	6.23	7.02
400 mb	1.07	1.01	1.45	0.117	1.10	8.21	7.54	7.85	7.43	7.92
300 mb	5.87	6.17	6.02	3.525	6.00	7.60	7.60	7.58	8.39	7.78
250 mb	6.66	7.12	6.89	4.562	6.90	7.29	7.66	7.46	9.13	7.74
200 mb	9.05	9.78	9.41	5.810	9.32	8.37	8.89	8.62	10.45	8.64
150 mb	10.02	9.87	9.94	5.568	10.00	10.19	10.34	10.23	11.22	10.36
100 mb	-2.53	-2.12	-2.32	-0.454	-2.13	8.35	8.73	8.54	8.38	8.60
70 mb	-	-	-	-0.934	-	-	-	-	5.46	-
50 mb	-6.74	-6.37	-6.55	-0.767	-6.61	11.71	12.39	12.02	10.15	11.93
30 mb	-	-		-1.708	-	-	-		13.88	-
20 mb	-	-		-3.871	-	-	-		14.47	-
10 mb	-	-		-7.299	-	-	-		14.12	-

WIND V-COMPONENT (METERS/SEC)

1000 mb	-	-	-	-1.34	-	-	-	-	1.70	-
850 mb	-4.76	-5.43	-5.10	-3.19	-5.03	2.80	2.80	2.81	3.13	3.30
700 mb	-1.45	-1.05	-1.25	-0.82	-1.29	2.15	2.11	2.14	2.71	2.51
500 mb	-1.45	-1.12	-1.29	0.04	-1.36	4.37	4.28	4.32	4.12	4.62
400 mb	-1.71	-0.94	-1.32	-0.34	-1.23	4.78	4.68	4.73	5.70	4.91
300 mb	4.55	5.07	4.81	1.69	4.90	7.74	8.09	7.90	7.67	8.02
250 mb	8.10	7.55	7.82	3.45	7.61	9.30	9.27	9.26	7.80	9.20
200 mb	7.70	7.21	7.45	3.84	7.42	9.19	8.56	8.86	8.70	9.03
150 mb	3.59	4.01	3.80	2.14	3.68	8.57	8.45	8.49	9.39	8.61
100 mb	-0.16	0.43	0.13	0.57	0.19	5.76	5.83	5.78	6.10	5.84
70 mb	-	-	-	-0.06	-	-	-	-	3.37	-
50 mb	0.39	-0.91	-0.26	-0.11	-0.55	2.88	2.97	2.99	3.21	3.12
30 mb	-	-	-	-0.08	-	-	-	-	3.56	-
20 mb	-	-	-	0.26	-	-	-	-	4.07	-
10 mb	-	-	-	0.14	-	-	-	-	4.54	-

Table 7-12. Maximum Differences in Means and Standard Deviations.

STATION: ALBROOK AFB, CZ MONTH: JANUARY

Number of Analysis Observations: 00Z 77 12Z 78

	WIND U - COMPONENT		WIND V - COMPONENT	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	-0.8	METERS/SEC	-0.7	METERS/SEC
	500	mb	850	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	-0.7	METERS/SEC	-0.4	METERS/SEC
	50	mb	300	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	5.7	METERS/SEC	-4.4	METERS/SEC
	50	mb	250	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	1.8	METERS/SEC	-1.5	METERS/SEC
	200	mb	250	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	5.8	METERS/SEC	-4.2	METERS/SEC
	50	mb	250	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	1.8	METERS/SEC	-1.4	METERS/SEC
	200	mb	250	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	0.4	METERS/SEC	0.3	METERS/SEC
	400	mb	50	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-0.4	METERS/SEC	-0.5	METERS/SEC
	700	mb	850	mb
Number of Pressure Levels Available at Station	15	levels	15	levels

Table 7-13. Values of Specified Parameters at Various Pressure Levels.

STATION: ALBROOK AFB, CZ (Tropical) MONTH: JULY

D-VALUE (METERS)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb	-	-	-	-34.00	-	-	-	-	14.40	-
850 mb	28.08	32.09	30.10	51.00	43.45	46.26	41.65	43.89	13.00	35.89
700 mb	116.44	117.01	116.73	134.00	142.76	52.15	46.72	49.32	14.30	67.11
500 mb	276.77	270.20	273.46	286.00	276.00	54.31	53.28	53.71	19.40	59.33
400 mb	377.73	373.87	375.79	386.00	389.38	62.64	56.93	59.66	23.70	64.47
300 mb	496.47	494.16	495.31	504.00	509.38	65.11	60.66	62.70	29.70	64.47
250 mb	560.68	559.74	560.20	562.00	549.93	68.40	64.60	68.28	34.90	81.86
200 mb	610.34	608.91	609.62	605.00	622.76	73.11	59.34	71.00	43.00	78.13
150 mb	560.33	562.47	561.40	561.00	555.00	77.24	73.06	74.92	50.00	85.00
100 mb	346.23	355.91	351.11	357.00	361.24	79.25	77.85	78.43	48.40	92.86
Δ 70 mb	202.82	215.93	209.60	194.00	192.00	20.15	30.49	26.63	51.60	36.30
50 mb	65.22	91.83	78.62	115.00	75.11	86.80	77.43	83.00	56.60	91.04
Δ 30 mb	47.82	65.67	57.05	70.00	58.00	34.70	43.56	40.21	68.70	34.88
Δ 20 mb	29.51	47.19	38.65	79.00	40.00	38.85	44.54	42.48	85.90	54.87
Δ 10 mb	41.79	69.67	56.20	146.00	50.00	47.92	60.50	56.11	111.80	63.62

TEMPERATURE (DEGREES CENTIGRADE)

1000 mb	-	-	-	25.63	-	-	-	-	1.99	-
850 mb	18.55	18.19	18.37	18.04	18.22	1.24	1.20	1.23	1.14	1.61
700 mb	10.73	10.00	10.36	9.67	10.16	1.17	1.23	1.25	1.24	1.49
500 mb	-8.08*	-5.82	-6.94*	-6.44	-6.64*	22.47	0.93	15.83*	1.05	6.45*
400 mb	-16.15	-15.97	-16.06	-17.10	-15.63	0.72	0.92	0.83	1.11	1.80
300 mb	-31.27	-31.09	-31.18	-32.23	-30.64	0.79	0.80	0.79	1.31	0.73
250 mb	-41.50	-41.65	-41.57	-42.44	-42.03	0.93	1.04	0.99	1.47	1.29
200 mb	-54.33	-54.21	-54.27	-54.91	-54.36	0.91	1.19	1.06	1.70	0.87
150 mb	-69.26	-68.94	-69.10	-68.86	-69.25	1.30	1.11	1.21	1.84	1.92
100 mb	-76.25	-76.08	-76.16	-74.89	-76.07	1.89	2.08	1.98	2.27	2.22
Δ 70 mb	-68.13	-67.48	-67.80	-68.01	-67.57	1.74	1.61	1.69	2.35	2.19
50 mb	-63.39	-62.25	-62.81	-61.36	-62.81	1.84	2.28	2.14	2.38	2.42
Δ 30 mb	-55.31	-55.29	-55.30	-53.39	-55.10	1.07	1.27	1.16	2.98	1.61
Δ 20 mb	-49.51	-49.48	-49.50	-48.32	-49.43	2.33	1.45	1.91	2.92	2.31
Δ 10 mb	-44.69	-43.09	-43.86	-40.96	-43.46	2.05	1.83	2.08	2.74	2.34

Table 7-14. Maximum Differences in Means and Standard Deviations.

STATION: ALBROOK AFB, CZ MONTH: JULY

Number of Analysis Observations: 00Z 72 (Δ 29) 12Z 73 (Δ 31)

	D-Values		Temperature	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	-27.9	meters	-1.6	degrees K
	10	mb	10	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	-12.6	meters	0.9	degrees K
	10	mb	20	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	89.8	meters	2.9	degrees K
	10	mb	10	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	55.7	meters	1.8	degrees K
	10	mb	30	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	96.0	meters	2.5	degrees K
	10	mb	10	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	48.2	meters	1.4	degrees K
	10	mb	30	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	-26.0	meters	0.5	degrees K
	700	mb	300	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-17.8	meters	-1.0	degrees K
	700	mb	400	mb
Number of Pressure Levels Available at Station	15	levels	15	levels

Table 7-15. Values of Specified Parameters at Various Pressure Levels.

STATION: ALBROOK AFB, CZ (Tropical) MONTH: JULY

WIND U - COMPONENT (METERS/SEC)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb	-	-	-	1.31	-	-	-	-	1.48	-
850 mb	-4.75	-6.45	-5.60	-3.00	-5.62	2.21	2.34	2.43	2.53	2.79
700 mb	-7.61	-7.87	-7.74	-5.82	-7.79	2.83	2.65	2.73	3.09	3.10
500 mb	-7.44	-5.97	-6.70	-6.85	-6.72	3.38	3.46	3.48	4.04	3.80
400 mb	-5.72	-4.11	-4.91	-5.85	-4.93	4.38	3.45	4.01	4.13	4.14
300 mb	-3.05	-2.67	-2.86	-4.32	-2.96	2.99	3.65	3.33	4.00	3.59
250 mb	-1.18	-1.91	-1.55	-4.23	-1.58	3.57	4.65	4.15	4.68	4.44
200 mb	-0.19	-0.84	-0.52	-3.14	-0.55	4.19	5.62	4.96	5.61	5.10
150 mb	2.76	1.53	2.14	-1.65	2.20	5.99	6.09	6.05	6.60	6.31
100 mb	-2.58	-1.49	-2.03	-6.09	-1.93	6.34	5.65	6.01	5.03	6.23
70 mb	-7.27	-7.93	-7.61	-8.85	-7.66	2.44	3.18	2.84	5.84	3.50
50 mb	-10.50	-11.80	-11.15	-12.36	-11.34	4.76	4.69	4.75	7.91	5.27
30 mb	-8.93	-10.29	-9.63	-15.90	-9.33	3.11	3.21	3.21	11.54	3.50
20 mb	-16.48	-16.38	-16.43	-19.86	-16.58	2.84	3.26	3.04	14.24	3.22
10 mb	-28.06	-28.29	-28.18	-27.93	-28.00	3.56	3.99	3.76	15.24	3.99

WIND V - COMPONENT (METERS/SEC)

1000 mb	-	-	-	-1.44	-	-	-	-	1.57	-
850 mb	-1.97	-1.89	-1.93	-2.07	1.69	2.04	2.31	2.17	2.38	2.22
700 mb	0.47	0.47	0.47	0.60	0.27	2.20	2.08	2.13	2.89	2.69
500 mb	1.48	2.09	1.79	1.91	1.62	2.67	2.28	2.49	2.46	2.73
400 mb	1.33	2.30	1.82	1.69	1.89	2.87	2.50	2.73	2.65	3.03
300 mb	0.54	1.13	0.84	0.88	0.96	3.53	3.14	3.34	3.47	3.70
250 mb	1.04	0.76	0.90	0.17	0.91	4.49	4.26	4.36	4.56	4.52
200 mb	0.86	0.31	0.58	-0.87	0.69	5.13	5.21	5.16	5.27	5.27
150 mb	0.16	-1.35	-0.60	-1.80	-0.69	4.85	5.09	5.01	5.35	5.23
100 mb	0.69	-0.02	0.33	0.28	0.24	2.92	2.71	2.83	3.18	3.11
▲ 70 mb	0.65	-0.80	-0.10	0.14	-0.33	1.49	1.77	1.79	2.61	2.71
50 mb	0.48	-0.23	0.12	0.49	0.13	1.77	1.93	1.88	2.56	2.55
Δ 30 mb	-0.86	0.03	-0.40	-0.64	-0.58	1.72	1.56	1.68	2.47	2.27
Δ 20 mb	-0.75	0.80	0.05	0.35	-0.16	2.19	1.92	2.19	2.52	2.59
Δ 10 mb	-0.20	0.64	0.23	0.32	-0.66	2.21	1.81	2.04	2.30	2.58

Table 7-16. Maximum Differences in Means and Standard Deviations.

STATION: ALBROOK AFB, CZ MONTH: JULY

Number of Analysis Observations: 00Z 72 Δ 29 12Z 73 Δ 31

	WIND U - COMPONENT		WIND V - COMPONENT	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	1.7	METERS/SEC	-1.6	METERS/SEC
	850	mb	20	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	-1.1	METERS/SEC	0.4	METERS/SEC
	250	mb	10	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	-6.3	METERS/SEC	-1.5	METERS/SEC
	30	mb	200	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	11.5	METERS/SEC	0.8	METERS/SEC
	10	mb	30	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	-6.6	METERS/SEC	-1.6	METERS/SEC
	30	mb	200	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	11.3	METERS/SEC	-0.4	METERS/SEC
	10	mb	400	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	-0.2	METERS/SEC	-3.6	METERS/SEC
	10	mb	850	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-0.7	METERS/SEC	-0.9	METERS/SEC
	70	mb	70	mb
Number of Pressure Levels Available at Station	15	levels	15	levels

Table 7-17. Values of Specified Parameters at Various Pressure Levels.

STATION: HALLETT, ANTARCTICA (Southern Hemisphere) MONTH: JANUARY

D-VALUE (METERS)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb	-148.10	-145.94	-147.02	-	-149.03	42.05	41.33	41.54	-	52.72
850 mb	-205.46	-204.45	-204.96	-262.00	-196.45	43.03	40.76	41.74	49.00	49.19
700 mb	-283.69	-282.31	-283.00	-350.00	-286.45	51.77	52.33	51.85	58.10	57.68
500 mb	-368.55	-364.69	-366.62	-469.00	-364.84	77.60	80.08	78.55	89.10	88.43
400 mb	-419.03	-412.74	-415.89	-	-419.03	93.56	99.61	96.29	-	104.34
300 mb	-479.39	-480.29	-479.84	-599.00	-477.10	113.68	110.13	111.47	126.50	108.70
250 mb	-488.55	-494.97	-491.76	-	-491.61	110.54	107.77	108.77	-	113.40
200 mb	-432.73	-443.40	-438.06	-551.00	-440.32	99.47	99.86	99.40	107.20	97.65
150 mb	-358.18	-365.26	-361.72	-411.00	-360.00	95.11	91.87	93.19	100.20	108.74
100 mb	-259.08	-266.92	-263.00	-223.00	-264.19	106.01	106.12	105.71	95.20	110.32
70 mb	-199.33	-205.31	-202.28	-	-206.82	104.70	100.27	101.97	-	100.36
50 mb	-104.86	-106.12	-105.49	-116.00	-105.18	122.15	117.93	119.32	101.80	125.55
30 mb	55.28	52.09	53.69	-	53.02	139.37	135.57	136.68	-	138.18
20 mb	66.49	54.95	60.72	-	60.00	164.21	149.03	155.99	-	161.52
10 mb	72.77	77.09	74.93	-	72.56	193.97	192.34	192.03	-	194.83

TEMPERATURE (DEGREES CENTIGRADE)

1000 mb	-0.56	-1.29	-0.93	-	-1.11	1.50	1.29	1.44	-	2.04
850 mb	-8.40	-9.02	-8.71	-10.07	-8.76	3.23	3.00	3.12	2.43	3.39
700 mb	-14.86	-15.27	-15.06	-18.67	-15.18	4.55	4.23	4.38	4.08	4.32
500 mb	-28.32	-28.39	-28.36	-31.51	-28.37	4.05	4.08	4.05	4.34	4.16
400 mb	-38.76	-38.89	-38.82	-	-38.73	3.55	3.41	3.46	-	3.62
300 mb	-50.94	-51.47	-51.20	-49.82	-51.08	3.55	2.64	3.13	3.77	3.33
250 mb	-49.63	-50.15	-49.89	-	-49.76	3.98	3.94	3.95	-	4.03
200 mb	-46.87	-46.71	-46.79	-43.14	-46.89	4.01	3.65	3.82	3.45	4.00
150 mb	-45.11	-44.81	-44.96	-41.76	-44.89	3.30	3.33	3.31	2.32	3.46
100 mb	-47.50	-47.63	-47.56	-40.63	-47.40	3.38	3.02	3.19	1.74	3.30
70 mb	-47.51	-47.57	-47.54	-	-47.44	2.58	2.19	2.38	-	2.52
50 mb	-46.36	-46.33	-46.34	-39.04	-46.64	2.15	1.87	2.00	1.39	2.26
30 mb	-47.33	-47.42	-47.37	-	-47.48	2.66	2.33	2.49	-	2.67
20 mb	-46.89	-47.42	-47.15	-	-47.43	3.17	2.23	2.74	-	2.92
10 mb	-47.40	-47.26	-47.33	-	-47.38	2.67	2.58	2.61	-	2.77

Table 7-18. Maximum Differences in Means and Standard Deviations.

STATION: HALLETT, ANTARCTICA MONTH: JANUARY

Number of Analysis Observations: 00Z 62 12Z 62

	D-Values		Temperature	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	11.5	meters	.7	degrees K
	20	mb	1000	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	15.2	meters	.9	degrees K
	20	mb	20	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	-119.2	meters	7.3	degrees K
	300	mb	50	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	-17.5	meters	-1.5	degrees K
	50	mb	100	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	-121.9	meters	7.6	degrees K
	300	mb	50	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	-23.7	meters	-1.6	degrees K
	50	mb	100	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	-8.5	meters	.3	degrees K
	850	mb	50	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-11.3	meters	-.3	degrees K
	1000	mb	50	mb
Number of Pressure Levels Available at Station	8	levels	8	levels

Table 7-19. Values of Specified Parameters at Various Pressure Levels.

STATION: HALLETT, ANTARCTICA (Southern Hemisphere) MONTH: JANUARY

WIND U-COMPONENT (METERS/SEC)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb										
850 mb	-0.50	0.03	-0.23	0.75	-0.01	4.47	3.34	3.94	3.75	4.17
700 mb	-1.95	-0.98	-1.46	-0.04	-1.42	5.57	5.83	5.70	4.80	5.89
500 mb	1.38	1.54	1.46	2.65	1.55	10.38	9.22	9.77	8.36	9.83
400 mb	1.51	2.96	2.24	-	2.20	12.14	13.47	12.79	-	12.79
300 mb	2.03	3.24	2.63	5.06	2.92	12.30	12.34	12.28	11.98	12.18
250 mb	1.95	2.24	2.09	-	2.00	10.75	10.37	10.52	-	10.63
200 mb	1.67	1.93	1.80	4.81	2.20	8.57	7.33	7.94	8.31	7.99
150 mb	0.06	0.21	0.13	4.05	0.22	6.74	6.44	6.57	6.65	6.78
100 mb	0.43	0.29	0.36	3.52	0.34	7.01	5.89	6.45	5.45	6.64
70 mb	0.30	0.67	0.48	-	0.43	5.80	4.43	5.13	-	5.16
50 mb	-1.53	-1.32	-1.43	0.90	-1.66	6.23	4.83	5.54	3.32	5.76
30 mb	-3.67	-4.48	-4.08	-	-3.93	5.83	5.26	5.53	-	5.91
20 mb	-3.58	-4.72	-4.15	-	-4.10	6.56	4.65	5.68	-	5.86
10 mb	-8.53	-8.72	-8.62	-	-8.29	6.01	5.95	5.95	-	6.00

WIND V-COMPONENT (METERS/SEC)

1000 mb										
850 mb	2.74	2.90	2.82	3.47	2.76	5.58	5.81	5.67	7.43	6.05
700 mb	0.33	0.74	0.54	2.76	0.50	5.91	5.41	5.65	7.32	5.84
500 mb	-3.96	-3.54	-3.75	-1.05	-3.76	6.33	6.06	6.17	7.02	6.11
400 mb	-5.74	-5.56	-5.65	-	-5.74	8.41	8.75	8.55	-	8.61
300 mb	-6.12	-6.37	-6.25	-2.31	-6.46	9.41	9.87	9.61	10.28	9.71
250 mb	-5.79	-5.87	-5.83	-	-5.94	6.98	7.40	7.17	-	7.40
200 mb	-5.33	-5.33	-5.33	-2.43	-5.29	5.19	4.87	5.01	6.22	5.19
150 mb	-7.32	-7.32	-7.32	-2.44	-7.23	5.87	5.92	5.87	5.12	6.08
100 mb	-7.29	-7.53	-7.41	-2.48	-7.31	7.25	6.40	6.81	3.33	6.93
70 mb	-3.34	-3.88	-3.61	-	-3.81	5.49	5.38	5.41	-	5.57
50 mb	-4.02	-4.18	-4.10	-2.00	-3.98	5.82	5.63	5.69	2.79	5.83
30 mb	-2.09	-2.76	-2.43	-	-2.36	6.36	6.20	6.25	-	6.26
20 mb	-0.30	-1.44	-0.87	-	-0.67	6.66	6.44	6.54	-	6.58
10 mb	0.09	-0.65	-0.27	-	-0.38	8.09	7.93	7.97	-	8.10

Table 7-20. Maximum Differences in Means and Standard Deviations.

STATION: HALLETT, ANTARCTICA MONTH: JANUARY

Number of Analysis Observations: 00Z 62 12Z 62

	WIND U - COMPONENT		WIND V - COMPONENT	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	-1.5	METERS/SEC	1.1	METERS/SEC
	400	mb	20	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	1.4	METERS/SEC	-0.5	METERS/SEC
	50	mb	250	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	3.9	METERS/SEC	4.9	METERS/SEC
	150	mb	100	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	-2.2	METERS/SEC	-3.5	METERS/SEC
	50	mb	100	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	3.8	METERS/SEC	4.8	METERS/SEC
	150	mb	100	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	-2.4	METERS/SEC	-3.6	METERS/SEC
	50	mb	100	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	-0.4	METERS/SEC	0.2	METERS/SEC
	200	mb	70	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-0.4	METERS/SEC	0.4	METERS/SEC
	30	mb	850	mb
Number of Pressure Levels Available at Station	8	levels	8	levels

Table 7-21. Values of Specified Parameters at Various Pressure Levels.

STATION: HALLETT, ANTARCTICA (Southern Hemisphere) MONTH: JULY

D-VALUE (METERS)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb	-177.59	-180.92	-179.22	-	-177.69	65.76	64.06	64.64	-	68.90
850 mb	-307.43	-304.57	-306.03	-353.00	-312.69	48.69	44.57	46.51	94.10	55.25
700 mb	-423.83	-419.86	-421.89	-517.00	-422.30	58.91	57.11	57.79	118.40	68.90
500 mb	-576.42	-569.90	-573.22	-721.00	-575.76	91.62	84.16	87.67	157.80	89.86
400 mb	-676.40	-668.45	-672.50	-	-668.07	106.69	95.95	101.15	-	102.07
300 mb	-799.23	-791.82	-795.60	-999.00	-790.38	123.49	111.83	117.41	190.10	124.13
250 mb	-853.49	-843.49	-848.59	-	-853.84	124.39	116.60	120.15	-	120.93
200 mb	-857.49	-829.80	-843.91	-1151.00	-845.76	115.81	115.35	115.86	180.00	119.27
150 mb	-809.59	-768.29	-789.34	-1255.00	-790.38	107.21	107.63	108.89	172.30	117.18
100 mb	-553.55	-517.82	-536.03	-1433.00	-538.84	92.39	89.36	92.24	183.60	98.21
70 mb	-413.77	-403.84	-408.90	-	-409.61	72.09	73.30	72.50	-	74.98
50 mb	-261.68	-254.92	-258.37	-1826.00	-259.61	63.25	64.37	63.58	220.90	70.17
30 mb	-74.83	-70.31	-72.62	-	-69.23	56.38	55.23	55.60	-	74.20
20 mb	-7.83	-2.90	-5.41	-	-3.46	59.04	55.92	57.31	-	66.79
10 mb	149.55	155.45	152.44	-	139.61	68.69	62.36	65.41	-	63.91
				TEMPERATURE (DEGREES CENTIGRADE)						
1000 mb	-16.59	-16.02	-16.31	-	-16.34	4.41	4.10	4.25	-	4.35
850 mb	-18.91	-18.39	-18.65	-26.52	-18.65	7.38	7.31	7.32	6.81	7.37
700 mb	-23.85	-23.61	-23.73	-28.29	-23.80	5.54	5.14	5.32	6.17	5.41
500 mb	-35.85	-35.80	-35.83	-40.50	-35.92	4.68	4.07	4.37	4.52	4.38
400 mb	-46.08	-45.96	-46.02	-	-45.84	3.55	3.05	3.30	-	3.30
300 mb	-58.55	-58.45	-58.50	-61.15	-58.53	2.52	2.30	2.41	2.30	2.86
250 mb	-57.72	-55.39	-56.58	-	-56.50	2.49	1.69	2.42	-	2.78
200 mb	-54.55	-49.75	-52.19	-67.15	-52.11	4.27	1.81	4.08	3.80	4.26
150 mb	-49.00	-46.69	-47.87	-69.11	-47.76	3.56	2.68	3.35	3.22	3.53
100 mb	-38.74	-38.35	-38.55	-73.30	-38.61	1.10	1.02	1.07	3.09	0.67
70 mb	-41.57	-41.33	-41.45	-	-41.80	1.15	0.99	1.08	-	1.71
50 mb	-42.04	-41.84	-41.94	-77.98	-42.34	1.40	1.16	1.28	3.27	1.35
30 mb	-43.00	-42.90	-42.95	-	-42.73	0.98	0.97	0.97	-	0.93
20 mb	-41.06	-40.77	-40.91	-	-40.96	1.17	0.95	1.07	-	1.95
10 mb	-36.85	-36.84	-36.85	-	-37.00	1.17	1.10	1.13	-	1.94

Table 7-22. Maximum Differences in Means and Standard Deviations.

STATION: HALLETT, ANTARCTICA MONTH: JULY

Number of Analysis Observations: 00Z 53 12Z 51

	D-Values		Temperature	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	-41.3	meters	-4.8	degrees K
	150	mb	200	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	11.7	meters	2.5	degrees K
	300	mb	200	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	-1567.6	meters	-36	degrees K
	50	mb	50	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	157.3	meters	2.0	degrees K
	50	mb	100	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	-1566.4	meters	-35.7	degrees K
	50	mb	50	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	150.7	meters	2.4	degrees K
	50	mb	100	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	12.8	meters	.4	degrees K
	10	mb	50	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-18.6	meters	-.9	degrees K
	30	mb	20	mb
Number of Pressure Levels Available at Station	8	levels	8	levels

Table 7-23. Values of Specified Parameters at Various Pressure Levels.

STATION: HALLETT, ANTARCTICA (Southern Hemisphere) MONTH: JULY

WIND U-COMPONENT (METERS/SEC)

	Ungrouped Mean 0000Z	Ungrouped Mean 1200Z	Ungrouped Combined Mean	Station Mean	Grouped Combined Mean	Ungrouped Standard Dev. 00Z	Ungrouped Standard Dev. 12Z	Ungrouped Combined Stnd. Dev.	Station Standard Deviation	Grouped Combined Stnd. Dev.
1000 mb										
850 mb	5.09	4.70	4.90	1.58	4.69	6.82	5.54	6.20	3.35	6.45
700 mb	9.41	8.92	9.17	2.08	9.16	7.89	6.64	7.28	6.33	7.43
500 mb	14.83	14.27	14.55	7.89	14.64	9.60	8.12	8.87	10.49	9.05
400 mb	16.56	16.78	16.67	-	16.80	11.01	9.22	10.12	-	10.30
300 mb	19.50	19.92	19.71	10.24	19.69	12.29	10.80	11.53	11.49	11.67
250 mb	21.24	21.49	21.36	-	21.23	12.69	11.08	11.87	-	11.88
200 mb	24.77	22.37	23.59	13.04	23.58	11.80	10.38	11.14	9.46	11.21
150 mb	27.15	20.27	23.77	15.97	23.87	11.83	9.01	11.04	7.99	10.91
100 mb	12.32	9.58	10.98	19.00	11.08	8.98	7.68	8.44	7.83	8.55
70 mb	9.56	8.31	8.95	-	8.87	6.05	5.42	5.75	-	5.96
50 mb	3.60	2.88	3.25	28.42	3.15	5.25	4.82	5.03	7.99	5.22
30 mb	-1.03	-1.33	-1.18	-	-1.07	3.72	3.63	3.66	-	4.25
20 mb	-4.01	-4.07	-4.04	-	-3.96	3.14	3.37	3.24	-	3.41
10 mb	-11.86	-12.15	-12.01	-	-12.08	3.77	3.90	3.82	-	3.98

WIND V-COMPONENT (METERS/SEC)

1000 mb										
850 mb	1.30	1.17	1.24	3.56	1.32	3.87	2.82	3.38	6.01	3.82
700 mb	0.98	1.13	1.05	1.22	1.08	4.70	3.53	4.15	7.02	4.44
500 mb	-1.28	-0.92	-1.10	-1.06	-1.17	5.32	4.56	4.94	9.17	5.17
400 mb	-2.96	-1.98	-2.48	-	-2.37	6.03	4.92	5.51	-	5.42
300 mb	-3.62	-3.19	-3.41	-0.23	-3.52	6.90	6.09	6.49	11.50	6.78
250 mb	-4.39	-3.94	-4.17	-	-4.10	6.96	6.02	6.49	-	6.71
200 mb	-4.94	-4.27	-4.61	0.42	-4.63	7.35	6.02	6.70	8.67	6.80
150 mb	-6.32	-5.11	-5.73	0.87	-6.07	7.13	5.86	6.54	8.77	6.65
100 mb	-8.50	-7.62	-8.07	0.48	-8.00	6.07	5.04	5.58	8.72	5.87
70 mb	-5.83	-6.07	-5.95	-	-6.02	4.41	4.09	4.23	-	4.31
50 mb	-6.58	-6.64	-6.61	1.20	-6.51	3.65	3.59	3.60	9.70	3.80
30 mb	-6.22	-6.35	-6.28	-	-6.36	2.59	2.79	2.68	-	3.07
20 mb	-7.03	-7.03	-7.03	-	-7.23	2.40	2.44	2.41	-	2.67
10 mb	-10.05	-10.15	-10.10	-	-10.06	2.49	2.62	2.55	-	3.16

Table 7-24. Maximum Differences in Means and Standard Deviations.

STATIONS: HALLETT, ANTARCTICA MONTH: JULY

Number of Analysis Observations: 00Z 53 12Z 51

	WIND U - COMPONENT		WIND V - COMPONENT	
Maximum Difference in UNGROUPED means (0000Z minus 1200Z)	6.9	METERS/SEC	-1.2	METERS/SEC
	150	mb	150	mb
Maximum Difference in UNGROUPED Standard Deviation (0000Z minus 1200Z)	2.8	METERS/SEC	1.3	METERS/SEC
	150	mb	150	mb
Maximum Difference in Means (STATION minus UNGROUPED COMBINED)	25.1	METERS/SEC	8.6	METERS/SEC
	50	mb	100	mb
Maximum Difference in Standard Deviation (STATION minus UNGROUPED COMBINED)	-3.1	METERS/SEC	6.1	METERS/SEC
	150	mb	50	mb
Maximum Difference in Means (STATION minus GROUPED COMBINED)	25.2	METERS/SEC	8.5	METERS/SEC
	50	mb	100	mb
Maximum Difference in Standard Deviation (STATION minus GROUPED COMBINED)	-3.1	METERS/SEC	5.7	METERS/SEC
	850	mb	50	mb
Maximum Difference in Means (UNGROUPED COMBINED minus GROUPED COMBINED)	0.2	METERS/SEC	0.3	METERS/SEC
	850	mb	150	mb
Maximum Difference in Standard Deviation (UNGROUPED COMBINED minus GROUPED COMBINED)	-0.5	METERS/SEC	-0.4	METERS/SEC
	30	mb	30	mb
Number of Pressure Levels Available at Station	8	levels	8	levels

Significance tests and skewness tests noted earlier in this report are not included in any summary form herein. The results of the "t" test for means and the Chi-square test for standard deviations at the 1% significance level for both the grouped and ungrouped data proved to be a maximum in areas where the interval size did not reflect the data range, all data being contained in three intervals or less. The skewness test noted earlier for the same grouped and ungrouped data showed generally 30% of the cases were skewed significantly when considering the limited number of cases and the short period of record.

All analyses data are contained in the computed means and standard deviations. Those data containing questionable values are annotated with an asterisk and are not included in the maximum difference information.

The analyses for one time for a single month contain a maximum of 30 observations times the number of months in the period of record. For example, stations 1-5 (Table 5) contain three years or a maximum of 90 observations for 00Z and 180 observations for 00Z and 12Z combined. Some fields not previously recorded were added during the POR and these are affixed with a triangle with the number of observations indicated on the bottom of the page in Table 7-(13-16) (Albrook AFB). The number of observations listed in the Analysis Observation entries of the righthand pages of Table 7 is the number of observations that are included for all levels and parameters with the exceptions as noted above.

The immediate need for a moisture analysis in the data base produced a usability study on the dew-point depression fields in the NHA only, since the TWA and SHA moisture parameters were not added to the analysis data base until April 1974 (Appendix B).

The study was limited to a time-by-time comparison of dew-point temperatures at nine stations and their nearest grid point for both 00Z and 12Z observations during January and July of 1971 and 1972. The stations and their corresponding grid points are listed in Table 8. The five levels included in the study were surface, 850 mb, 700 mb, 500 mb, and 400 mb.

A comparison of these January and July values indicated the greatest amount of variability at the surface in polar latitudes, especially in January. The cause of the differences are due to the sharp horizontal gradients at these latitudes and proximity of the station and the grid point. In general, comparisons at all other levels indicated the difference between the two dew points to be less than three degrees. These larger differences always occurred when the dew-point depression was greater than ten degrees.

The lack of dew points at the 500 mb and 400 mb in the station data made any meaningful comparison impossible. This fact weighs heavily in favor of utilization of the gridded dew-point depressions at these levels since they are generally available when an analysis is made. The inclusion of dew-point

depressions in the analysis data base will significantly enhance the application of the data base.

Table 8. Station and Grid-Point Comparisons.

Station	No.	Lat.	Long.	I	J
Thule, Greenland	4202	76°33'N	68°49'W	25	30
Athens, Greece	16716	37°54'N	23°44'E	39	23
Tura, Russia	24507	64°17'N	100°15'E	24	19
Beirut, Lebanon	40100	33°49'N	35°29'E	39	19
Delhi, India	42182	28°36'N	77°12'E	31	9
Sapporo, Japan	47412	43°03'N	141°20'E	16	16
Adak, Alaska	70454	51°53'N	176°38'W	13	25
Jackson, Mississippi	72235	33°29'N	90°59'W	21	43
Baker Lake, Canada	72926	64°18'N	96°00'W	22	33

Limitation of the Comparisons

The bulk of the comparisons and the limitations of these comparisons are contained in a previous portion of the text. This section will include general comments on each type of data (station and grid-point) and on each of the parameters.

The station data used in the comparisons were from available station summaries with no attempt made to update the existing climatologies. These summaries were not updated because of priorities and lead time required to provide these updates. Thus, the comparisons are based on different PORs in time and this must be considered when studying the information in Table 7. The location of the station relative to the grid point must also be considered. Furthermore, many of the stations have limited readings at the higher levels and are biased as a function of when the sensing device reached these altitudes.

The analyses fields used in the comparison table are from models that contain limitations inherent in all numerical analysis methods. Furthermore, the analyses receive all of their input from the station data and climatologies of these data. The models continually undergo changes because of improved techniques. Recently, Vertical Temperature Profile Radiometer (VTPR) data from satellites have been added. This will facilitate the preparation of temperature profiles in data-sparse areas and add greatly to their accuracy. The parameters were found to compare most favorably in the data-dense areas, which is as one would expect.

Of the four parameters considered, in general, the temperature parameter agrees closest between station and analyses data over the entire globe. However, one area of sharp contrast is the SHA July data at high latitudes where

the analysis temperature is 30° warmer at 100 mb than the station data indicate. Such differences will possibly be significantly reduced with the use of VTPR information.

D-values show the widest variation in the area of the SHA, as previously noted. Nevertheless, in general, D-value fields from the analyses agree very well in sign and relative magnitude with the station data. The absolute difference between station and analyses D-values is largest where the magnitude of the numbers is greatest.

The wind comparisons display good correlation in sign and relative magnitude. The same characteristics of maximum difference are present as were noted for the D-value comparisons.

LIST OF USAFETAC TECHNICAL NOTES

Number	Title	Date
73-1	Interim Instructions for the Use of Air Stagnation Weather Charts and Messages (AWS distribution only)	Jan 73
73-2	The Ocheltree Tornado, A Case Study	Mar 73
73-3	Listing of Seminars Available at Hq AWS, AWS Wings, and AFGWC (AWS distribution only) (AD-757543)	Mar 73
73-4	USAFETAC Refractive Index Gradient Summaries (AD-762501)	Apr 73
73-5	Short-Range Weather Forecasting: Recent Developments in Air Weather Service, Suggested Techniques (AWS distribution only)	May 73
73-6	A Resumé on the State of the Art for Snow Forecasting (AD-767214)	Jul 73
74-1	Atmospheric Moisture Parameterization (AD-784814)	Jan 74
74-2	Development of a Gridded Data Base (AD-)	Apr 74

78-50939