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AVE/VAS I: 25 MB SOUNDING DATA

By Meta E. Sienkiewicz Texas A&M University College Station, Texas 77843

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example of contact data is given. Termination pressures of soundings are tabulated, as are observations of ground temperature at a depth of 2 cm.

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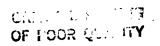


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AVE/VAS I: 25 MB SOUNDING DATA

by

Meta Sienkiewicz Texas A&M University College Station, Texas

1. Introduction

The AVE/VAS field experiment was conducted on five operational days during the Spring of 1982. The dates and observation times for this experiment are given in Table 1.

This report is primarily a data document containing rawinsonde data taken in a special meso- β -scale rawinsonde network for the first (shakedown) day, AVE/VAS I (6-7 February, 1982). A description of the data processing method, together with the FCRTRAN program for computing soundings and an error analysis, have been presented by Fuelberg (1974). A description of the synoptic conditions, observed weather, selected satellite photographs, and summaries of severe and unusual weather will be presented in a separate report.

2. AVE/VAS I (Shakedown)

Thirteen special rawinsonde stations and one National Weather Service station participated in AVE/VASI. A list of the stations is presented in Table 2 and their locations are shown in Fig. 1. Table 3 gives locations and station heights in the special station network. Soundings were taken at three times: February 6, 1982 at 1200 and 1800 GMT, and February 7, 1982, at 0000 GMT.

3. Rawinsonde Data

3.1 Methods of Processing. All processing of the data (coding, error checking, and final computations) was performed at Texas A&M University.

The procedure used to compute the soundings is the same as that used for previous AVEs and is described by Fuelberg (1974). All keypunched input

¹ Research Associate

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Table 1. Listing of operational days and sounding times in the AVE/VAS field experiment.

Operational Day	Dates	Observation Times
AVE/VAS I (Shakedown *)	6-7 February 1982	2/6 - 12, 18 2/7 - 00
AVE/VAS II	6-7 March 1982	3/6 - 12, 15, 18, 21 3/7 - 00, 03, 06, 12**
AVE/VAS III	27-28 March 1982	3/27 - 12, 15, 18, 21 3/28 - 00, 03, 06, 12**
AVE/VAS IV	24-25 April 1982	4/24 - 12, 15, 18, 21 4/25 - 00, 03, 06, 12**
AVE/VAS V	1-2 May 1982	5/1 - 12, 15, 18, 21 5/2 - 00, 03, 06, 12**

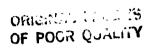
* Meso-8 network only on shakedown

^{**} Final 1200 GMT sounding at NWS stations only

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Table 2. Rawinsonde stations participating in the AVE/VAS field experiment.

Station Number	Location
<u>Spe</u>	cial Stations
001	Crowell, TX
002	Henrietta, TX
003	Durant, OK
004	Throckmorton, TX
005	Denton, TX
006	Abilene, TX
007	Ennis, TX
008	Brownwood, TX
009	Hewitt, TX
010	Menard, TX
011	Burnet, TX
012	College Station, TX
100	Ft. Hood, TX
<u>N</u>	WS Stations
260	Stephenville, TX



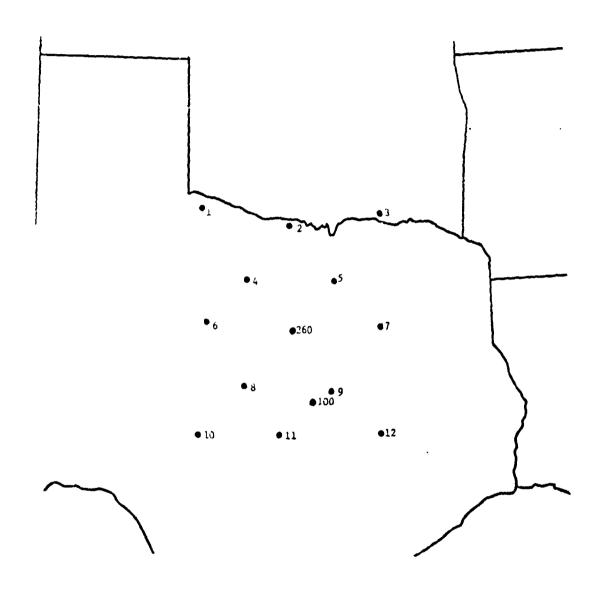


Figure 1. Location of rawinsonde stations participating in AVE/VAS I.

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Table 3. Locations of special rawinsonde stations participating in AVE/VAS I.

Station		Height(m)	Latitude(^O N)	Longitude(^O W)
Crowell, TX	(001)	450	33.98	99.71
Henrietta, TX	(002)	288	33.94	98.22
Durant, OK	(003)	211	33.94	96.40
Throckmorton, TX	(004)	405	33.19	99.18
Denton, TX	(005)	193	33.20	97.19
Abilene, TX	(006)	532	32.43	99.69
Ennis, TX	(E07)	150	32.33	96.66
Brownwood, TX	(800)	502	31.71	99.10
Hewitt, TX	(009)	184	31.48	97.20
Menard, TX	(010)	588	30.94	99.81
Burnet, TX	(011)	387	30.74	98.23
College Station, TX	(012)	79	30.64	96.47
Ft. Hood, TX	(100)	289	31.10	97.40
Stephenville, TX	(260)	399	32.22	98.18

data were checked for errors by calculating centered differences on the input data. Additional checks included centered differences on computed winds and checks on lapse rates of computed temperatures and dew points. Constant pressure analyses were made using meso- β -network data and compared to NWS data received on facsimile and teletype. Suspected errors were checked against the original strip chart information and appropriate corrections made.

The final rawinsonde data set of AVE/VAS I (shakedown) consists of data computed at each pressure contact, while winds were computed from the available 30- or 60-s interval data by means of centered finite differences, and subsequently interpolated to each contact or 25-mb level.

It should be noted that humidity values, including dew point temperatures, were computed only at temperatures above -40°C; at temperatures below -40°C, humidity values are missing and are indicated by a field of nines (e.g., 99.9 or 999.9). Moisture values were computed if the relative humidity exceeded 1%. If the value was below 1%, it was set equal to 1% and used in the computation of other moisture variables. The humidity equations described by Fuelberg (1974) were used in processing data from sondes using the old-type hygristors; computations for sondes with new carbon hygristors were performed using humidity equations currently in use by the National Weather Service.

3.2 Accuracy Estimates. Estimates of the r.m.s. errors in the wind and thermodynamic quantities of the AVE/VAS I data are the same as those for all previous //Es and are given by Fuelberg (1974). The error estimates for thermodynamic variables are presented in Table 4.

The r.m.s. errors for wind speed and direction are difficult to describe since they are a function of tracking geometry and other factors.

Maximum r.m.s. errors for winds (speed and direction) computed at 30-s intervals (based on the worst geometric tracking configuration) for 10 and 40 degree elevation angles are presented in Table 5. The accuracy of the wind data at pressure contacts at 25-mb intervals is greater than that stated for the 30-s winds because of the added smoothing, and interpolation performed. In addition, the errors stated for the 30-s wind were maxima for the stated conditions.

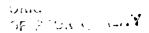
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Table 4. Estimates of the RMS errors in thermodynamic quantities of AVE/VAS rawinsonde data.

Parameter	Approximate RMS Error
Temperature	0.5°C (Fuelberg's value is 1°C)
Pressure	1.3 mb from surface to 400 mb; 1.1 mb between 400 and 100 mb; 0.7 mb between 100 and 10 mb.
Humidity	10 percent
Pressure Altitude	10 gpm at 500 mb; 20 gpm at 300 mb; 50 gpm at 50 mb.

Table 5. Estimates of RMS errors in AVE/VAS rawinsonde wind data.

	RMS errors (m s	s in speed	RMS errors (deg) in direction
Pressure	10 deg el	40 deg el	10 deg el	40 deg el
700	2.5	0.5	9.5	1.3
500	4.5	0.8	13.4	1.8
300	7.8	1.0	18.0	2.5



3.3 Presentation of Data. An example of AVE/VAS I contact data is given in Table 6, with the explanation of column headings in Table 7. The first line of data for time 0.0 minutes is surface data. A series of nines is used to indicate missing data. The three numbers in the upper right-hand corner are the number of pressure levels computed, the minimum pressure obtained (mb), and an angle identifier with the value of 0 for 30-s ingle input and 1 for 1-min angle input.

Winds based on low elevation angles are denoted by asterisks. One asterisk denotes elevation angles less than 10° but greater than 6° , while two asterisks denote angles less than 6° . These levels have been specially noted because caution must be exercised in the use of the data; winds computed at low elevation angles are subject to rather large r.m.s. errors.

Levels containing temperatures or times which have been interpolated are also denoted by asterisks. Missing temperatures and times at contacts are replaced by linear interpolation. A limit was set on this interpolation so that it would not extend for more than five contact levels. Interpolation over deeper layers could lead to inaccurate temperatures and geopotential heights, especially if data were missing in a surface inversion or near the tropopause. The deeper layers of missing data which exceed the five contact limit are denoted by two asterisks.

The contact data interpolated to 25-mb intervals are presented in Appendices I and II. The column headings are identical to those used for the contact data and are described in Table 7. The soundings are arranged by station number beginning with the special stations, and appear ir ascending order by time for each station. The first line of each sounding is surface data, followed by data from 1,000 to 25 millibars (or to termination) successively. For the 25-mb levels where the pressure is greater than the surface pressure, missing data (nines) are indicated for each quantity. This is also done for 25-mb levels above the sounding termination point.

Table 8 contains a listing of actual sounding launch times and termination pressures for the special soundings taken for AVE/VAS I.

3.4 <u>Soundings with Abnormal Characteristics</u>. The sounding data collected during AVE/VAS I are generally of good quality following the processing and rigorous error checking. It is difficult to determine whether any

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Example of AVE/VAS contact sounding data.

Table 6.

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Table 6. Continued.

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Table 6. Concluded.

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Table 7. Explanation of column headings of tabulated sounding data for AVE/VAS I.

	The second secon
TIME (MIN)	Time after balloon release.
CNTCT	Contact number,
HEIGHT (GPM)	Height of corresponding pressure surface in geopotential meters.
PRES (MB)	Pressure in millibars.
TEMP (DG C)	Ambient temperature in degrees Celsius. NOTE: An asterisk indicates that time from release and/or temperature were linearly interpolated.
DEW PT (DG C)	Dew-point temperature in degrees Celsius.
DIR (DG)	Wind direction measured clockwise from true north and is the direction from which the wind is blowing.
SPEED (M/SEC)	Scalar wind speed in meters per second. NOTE: An asterisk indicates that wind quantities are based on an elevation angle that is between 10° and 6°. A double asterisk indicates that the elevation angle is less than 6°.
U COMP (M/SEC)	The E-W wind component, positive toward the east and negative toward the west.
V COMP (M/SEC)	The N-S wind component, positive toward the north and negative toward the south.
POT T (DG K)	Potential temperature in degrees Kelvin.
E POT T (DG K)	Equivalent potential temperature in degrees Kelvin.
MX RTO (GM/KG)	Mixing ratio in grams per kilogram.
RH (PCT)	Relative humidity in percent.
RANGE (KM)	Distance balloon is from release point along a radius vector.
AZ (DG)	Direction toward balloon measured clockwise from true north.

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Table 8. Launch time (GMT) and termination pressure (mb) for soundings taken for AVE/VAS I.

Crowell, TX	*	1723	2306
Clowell, ix	••	47 mb	102 mb
	1157	1700	
Henrietta, TX	79 mb	61 mb	*
Durant, OK	**	**	**
Throckmorton, TX	**	*	*
Denton, TX	*	*	2302
bencon, ix			18 mb
41 +1 my	4.4	4.4	2310
Abilene, TX	**	**	90 mb
D1- (DV	1145	1704	2300
Ennis, TX	298 mb	462 mb	107 mb
n wv	*	1722	*
Brownwood, TX	^	13 mb	•
II. 166 TV	*	1713	2300
Hewitt, TX	•	397 mb	12 mb
Managai MV	1225	1714	2318
Menard, TX	11 mb	19 mb	57 mb
n . mr	*	1712	2320
Burnet TX	^	11 mb	13 mb
O.11aaa Charles MV	1401	1701	2338
College Station, TX	213 mb	200 mb	164 mb
The Name of the Na	1118	1718	2305
Ft. Hood, TX	560 mb	386 mb	353 mb
Chambe widlie TV	***	1715	***
Stephenville, TX	n n n	11 mb	**************************************

^{*} No data available due to equipment problems.

^{**} Operators unable to reach station in time to make the launch.

^{***} Sounding not available.

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unresolved errors remain in the data because so few complete soundings were taken.

Six soundings had missing temperature data for more than five consecutive contacts. These soundings along with the extent of missing data are listed in Table 9. Temperatures in these layers were not computed since linear interpolation was considered to be inaccurate. Geopotential heights could not be computed above these layers of missing temperature.

Appendix II contains a second copy of the affected soundings with temperatures interpolated through the missing data layers. Computed geopotential heights in these soundings should be used with caution (if at all), and other derived quantities (wind direction, speed, u- and v-components, and sonde range and azimuth) should be carefully considered before use.

4. Other Data

Ground temperatures at a depth of 2 cm (approx.) were taken at special stations maintained by TAMU. These measurements were taken immediately after the sounding launch. These temperatures are presented in Table 10.

Table 9. AVE/VAS I soundings with data missing for more than five successive contacts.

Station		Date/GMT	Explanation
Henrietta, TX	(002)	6/1157	Missing data 786-514 mb
Abilene, TX	(006)	6/2310	Missing data 179-133 mb, 115-99 mb
Hewitt, TX	(009)	6/1713	Missing data surface-863 mb
Menard, TX	(010)	6/1225 6/2318	Missing data surface-764 mb Missing data surface-363 mb
College Station, TX	(012)	6/2338	Missing data surface-939 mb

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Table 10. Ground temperatures ($^{\circ}$ C) at a depth of 2 cm at TAMU special rawinsonde stations on February 6-7 1982.

Station		Time (GMT)	•
	12	18	00
Crowell, TX	***	0.0	0.2
Henrietta, TX		0.9	2.9
Durant, OK			
Throckmorton, TX			
Denton, TX		-0.1	0.1
Abilene, TX			2.3
Ennis, TX	-4.0	-0.3	2.8
Brownwood, TX		1.9	3.9
Hewitt, TX	-5.0	-3.7	-0.7
Menard, TX	-5.0	-2.3	-0.5
Burnet, TX	0.9	1.1	4.0
College Station, TX	1.3	4.3	4.0

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Acknowledgements

A number of people have assisted in the production of this report. Their help is greatly appreciated. The author would like to acknowledge the efforts of the following people:

Dr. Robert E. Turner, Chief, and the personnel of the Environmental Applications Branch, Atmospheric Sciences Division, NASA/MFSC, who collected the sounding data from the National Weather Service stations.

Luke P. Gilchrist, president of GLG Company, Inc. He assisted in setting up the special rawinsonde stations manned by TAMU.

Jake Canglose, who provided expert guidance for the five TAMU technicians. Their efforts in maintaining, repairing, and sometimes even rebuilding the equipment used in the special network made the collection of this sounding data possible.

Dr. James R. Scoggins, who directed the field program conducted by TAMU, and the forty student workers who participated in the field work. These people risked life and limb; facing up to icy roads, adverse weather conditions, and unfriendly local law enforcement officials in order to collect the sounding data presented in this report.

Reference

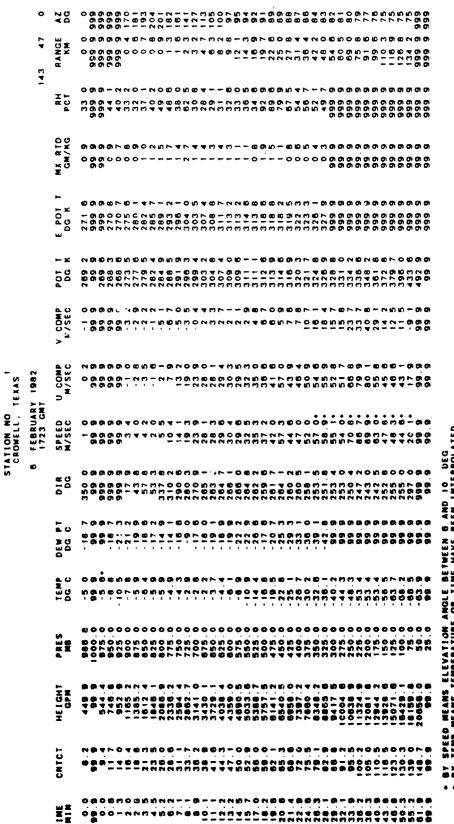
Fuelberg, H.E. 1974: Reduction and error analysis of the AVE II pilot experiment data. NASA Contractor Report CR-120496. Marshall Space Flight Center, Alabama, 140 pp.

APPENDIX I

AVE/VAS I Rawinsonde Data

Presented at 25-mb Intervals

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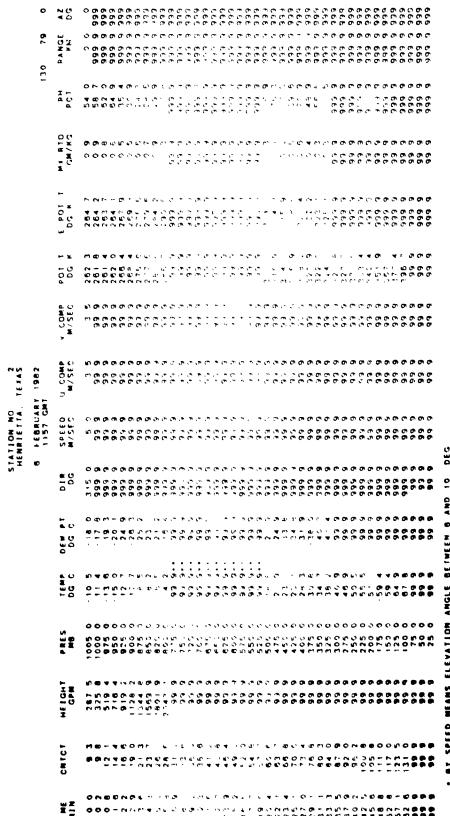


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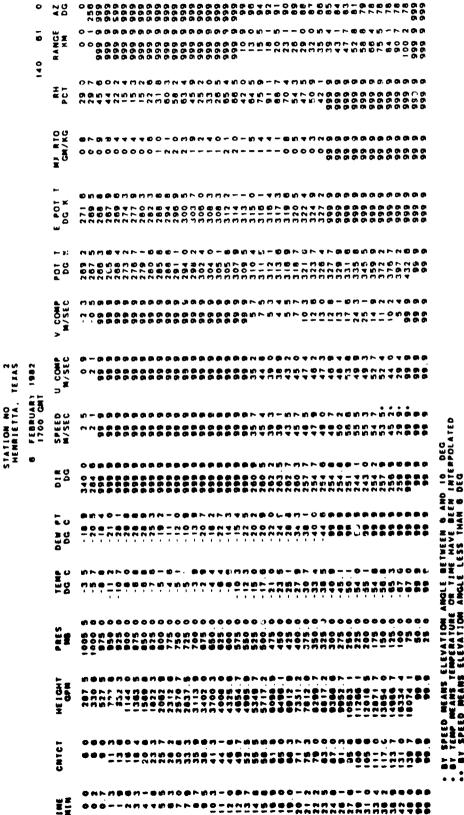
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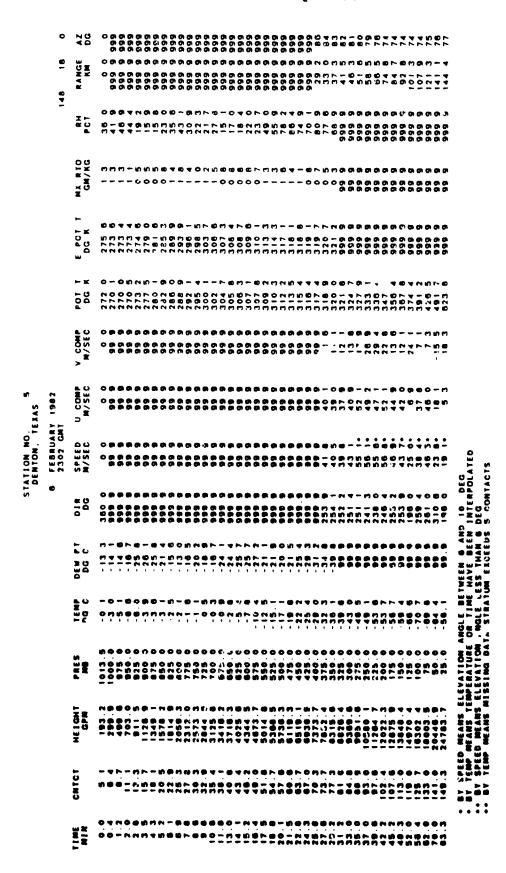


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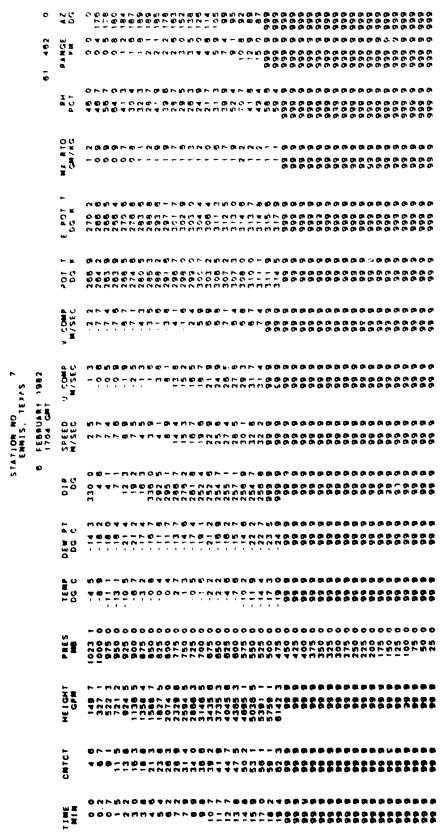
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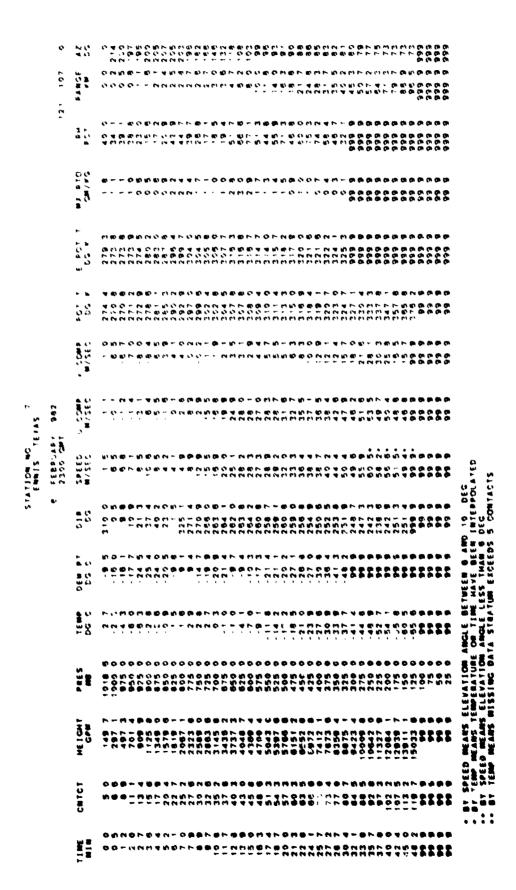
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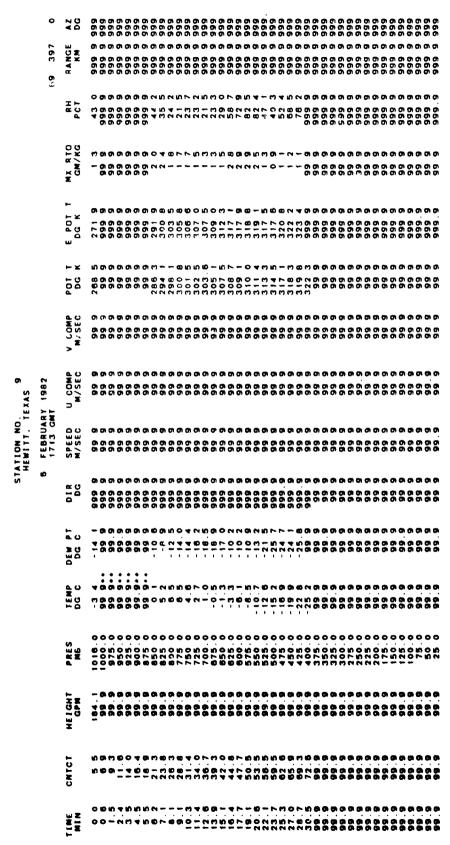


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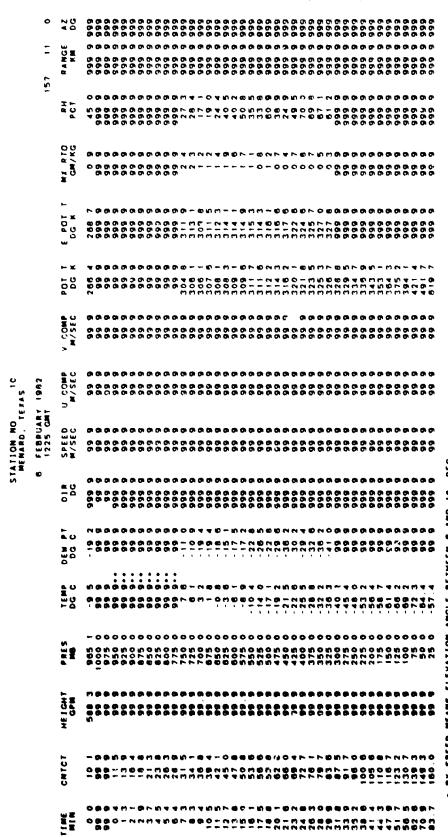


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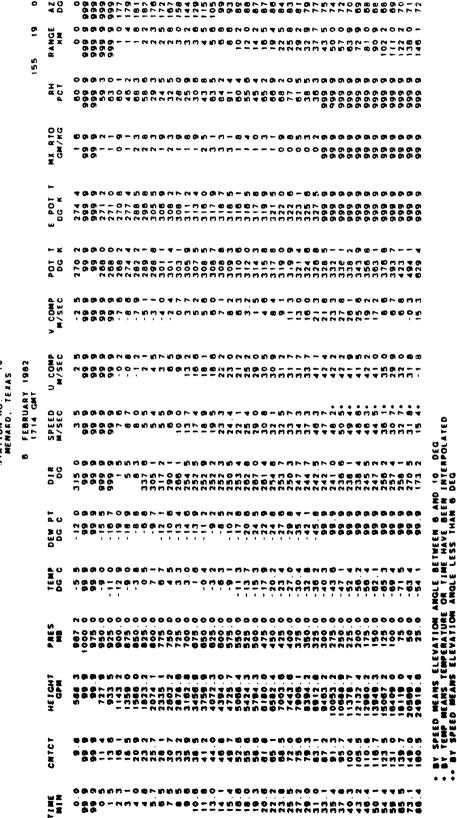
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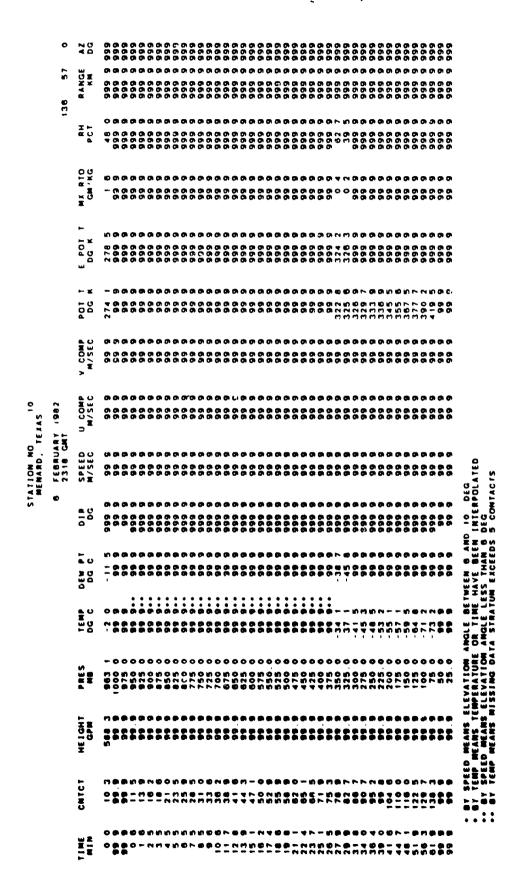


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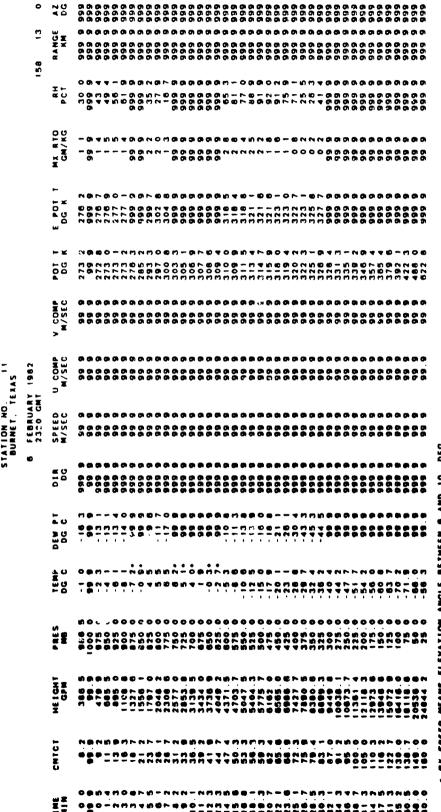
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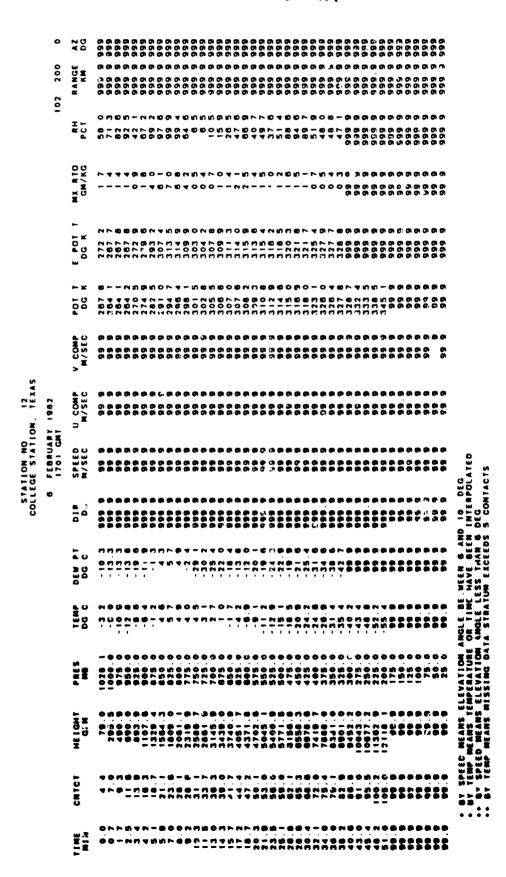


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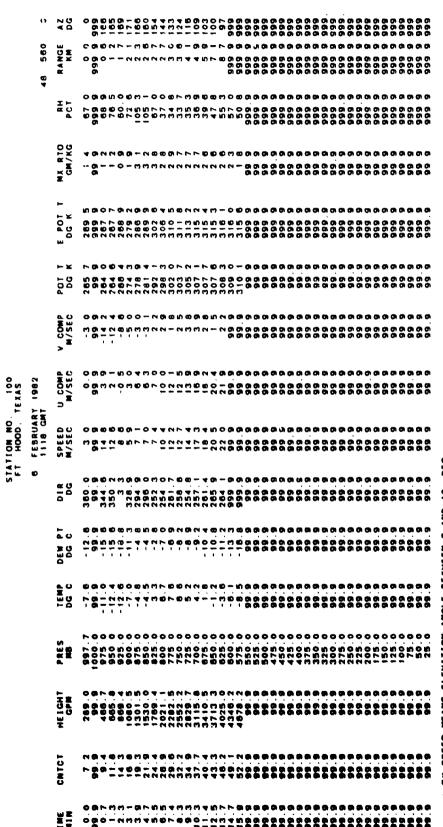
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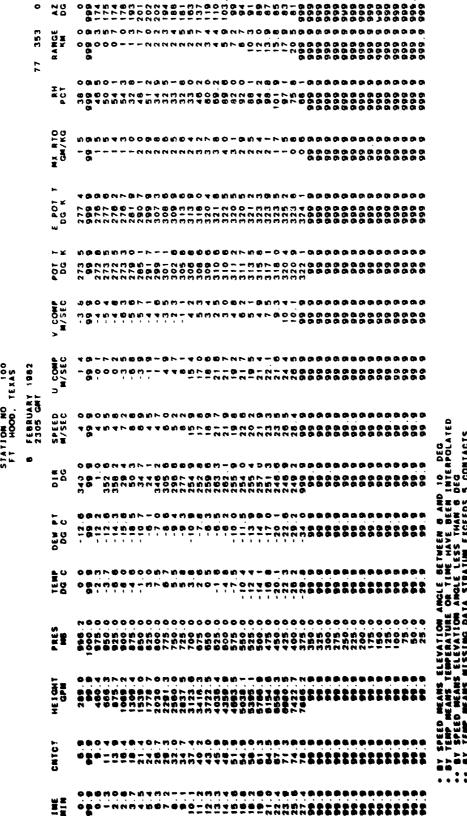


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APPENDIX 11

AVE/VAS I Rawinsonde Data with Abnormal Characteristics Presented at 25-mb Intervals

STATION NO. 2 HENRIETTA, TEXAS FEBRUARY

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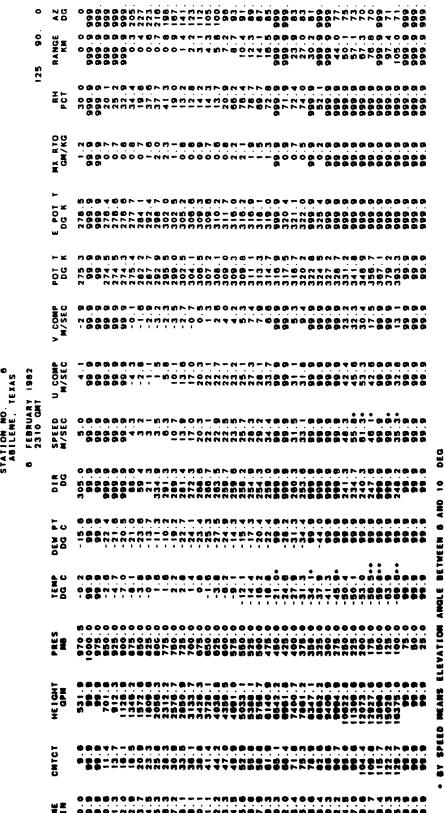
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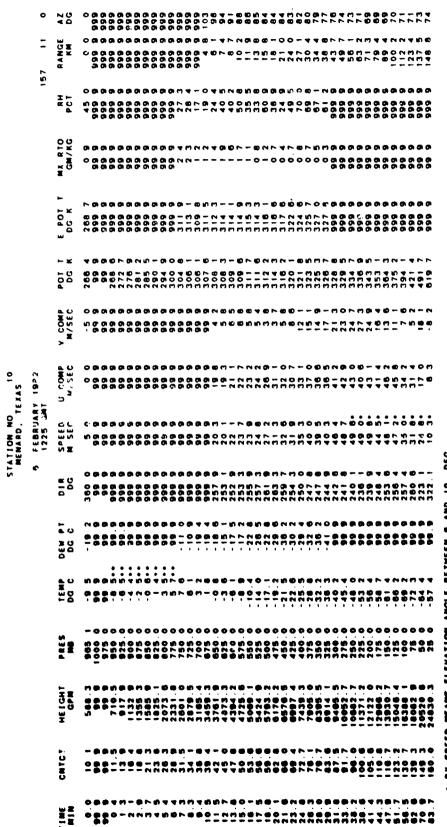


Y SPEED MEANS ELEVATION ANGLE BETWEEN 6 AND 10 DEG Y TEMPREADS TEMPERATURE ON TIME NAVE BEEN INTERPOLATED BY SPEED MEANS ELEVATION ANGLE LESS THAN 6 DEG BY TEMP MEANS MISSING DATA STRATUM EXCEEDS 5 CONTACTS

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BY SPEED MEANS ELEVATION ANGLE BETWEEN G AND 10 DEG by Temp means temperations of time have meen interpolated • By Speed Means Elevation angle less than 6 Deg • By Temp means missing data stratum exceeds 5 contacts

ORIGINAL PAGE 19 OF POOR QUALITY



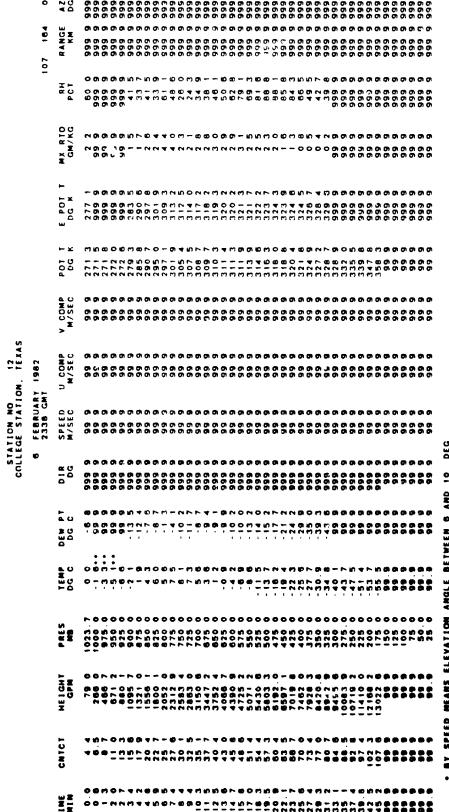
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BY SPEED MEANS ELEVATION ANGLE BETWEEN 6 AND 10 DEG.

- BY TEMP MEANS TEMPERATURE OF TIME NAVE BEEN INTERPOLATED.

- BY SPEED MEANS ELEVATION ANGLE LESS THAN 6 DEG.

ORIGINAL PAGE 15 OF POOR QUALITY



BY SPEED REAMS ELEVATION ANGLE BETWEEN 6 AND 10 DEG BY TEMP MEANS TEMPERATURE OR THE NAVE BEEN INTERPOLAT BY SPEED REAMS ELEVATION ANGLE LESS THAN 6 DEG BY TEMP MEANS MISSING DATA ST.ATUM EXCEEDS 5 CONTACTS