CRH SSD
JUNE 1994

CENTRAL REGION TECHNICAL ATTACHMENT 94-11

EXAMPLES OF UNUSUAL SOUNDINGS OBTAINED VIA MicroART

David R. Eversole
Weather Service Office
Kansas City, Missouri

1. Introduction

This paper will show three unusual soundings from the MicroART radiosonde program which contain correct data, but could be incorrectly interpreted as containing bad data. Data from radiosondes sometimes contain anomalous data, and at times the user must edit the data before sending it out. Several factors, such as equipment failure or incorrect calibration may lead to bad data. Although most operators have been trained to interrogate and remove erroneous data, there are times when correct data may be mistakenly assumed to be bad. Three sounding examples will be discussed, all of which contain good data, but could be incorrectly assumed to be in error. These soundings will help the MicroART user to be more knowledgeable and more prepared to properly edit radiosonde data.

The three sounding examples in this paper were collected by the author at WSMO Monett, Missouri. Examples will show cases of 1) a very dry layer aloft, 2) a RADAT with seven freezing levels, and 3) an example of when the MicroART system incorrectly flagged a humidity sensor failure. Where applicable, the actual MicroART commands are included to assist the user in his or her own investigations of other soundings.

2. Unusual Soundings

a. Case #1: A Very Dry Layer Aloft

In this case, a strong high pressure system was located over the Central Plains. Due to descending air, adiabatic heating led to drying of the atmosphere, resulting in unusual, but correct sounding data. Figure 1 shows the plot of temperature and relative humidity vs time (PL MET). Dry air aloft begins to show up after only three minutes of flight and by about seven minutes, the air was very dry with the relative humidity reaching as low as 1.7 percent at one point!

ation: Monett, MO
croART Rework Program

Ascension: 609-1 Release: 11:03 4-OCT-92
Version 1.45 Print: 12:55 5-OCT-92

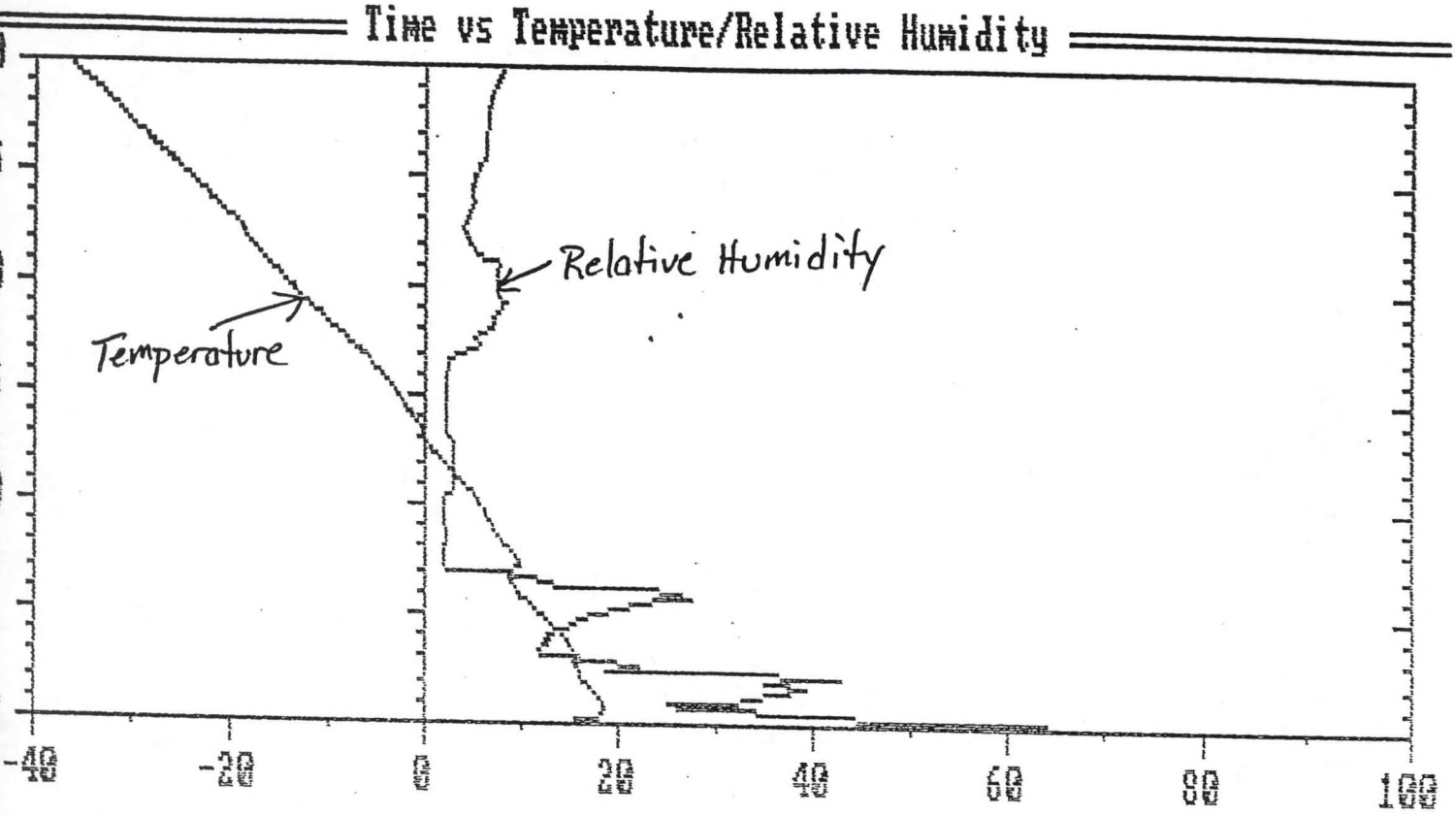

Figure 1. Plot of Time vs Temperature and Relative Humidity Ascension 609-1.

In this case, one can eliminate the chance for equipment failure or malfunction for four reasons: 1) the current synoptic pattern agreed with the sounding, 2) the previous sounding twelve hours ago and the next sounding twelve hours later showed dry air aloft as the high pressure system approached and left the region, and 3) a relative humidity sensor failure is indicated by an open circuit (which reads nearly 100 percent), but in this case the sensor was conducting current (values less than 90 percent were reported), and 4) the sensor was reporting values in all ranges and did not remain stuck at a constant value or behave in a spurious manner.

Whenever the relative humidity goes below 20 percent, the data is still coded as 20 percent in the mandatory and significant levels. So, the flight summary data (SUM) and the levels data (LEV) will not indicate the actual dryness of the air. This can be seen in Table 1, a listing of the levels data. To obtain a listing of the actual humidity values, type MET for lists of the temperature and humidity, as well as pressure.

Table 1 - Levels Data for Ascension 609-1

Time(min)	Pressure(mb)	Temp(C)	RH(%)	Reason
0.0	964.1	10.2	95.0	SFC
0.1	961.2	14.2	72.1	TEMP
0.2	958.4	16.7	56.2	TEMP
0.3	955.3	17.8	46.8	TEMP
0.6	946.3	18.5	32.4	TEMP
0.9	938.6	18.4	25.1	RH
1.3	925.0	17.7	34.8	MAND
2.0	907.2	16.2	37.1	TEMP
2.2	901.8	15.9	42.8	RH
2.4	896.4	16.0	20.0	RH
4.1	850.0	13.9	20.0	MAND
6.0	802.6	9.4	20.0	TEMP
6.8	781.9	8.3	20.0	TEMP
7.3	769.6	9.8	20.0	TEMP
8.8	732.8	6.9	20.0	TEMP
10.2	700.0	5.3	20.0	MAND
12.9	637.3	0.0	20.0	FRZ
13.4	626.4	-0.3	20.0	TEMP
16.7	559.9	-5.9	20.0	TEMP
19.9	500.0	-13.5	20.0	MAND
22.6	451.7	-18.8	20.0	TEMP
25.8	400.0	-26.5	20.0	MAND
29.9	340.4	-36.5	20.0	TEMP
31.7	317.1	-39.4	20.0	TEMP

b. Case #2: A RADAT with seven freezing levels

This case is unusual because seven freezing levels were identified by the MicroART system. One might be tempted to believe that this portion of the sounding was invalid, since the subtle variations in temperature that resulted in multiple freezing levels (Figure 2) might solely be a result of within-tolerance variations of the temperature sensor. Although it is difficult to be certain, all seven of these freezing levels are probably real. The following are possible reasons: 1) Warm advection in the lower levels could result in this temperature profile, and warm advection is supported in two ways: a) the relative humidity data indicated high humidities through eight minutes of flight, indicating warm, moist air, and b) the winds were veering in the lower layers, implying warm air advection; 2) No superadiabatic lapse rates were observed in these layers, which would have suggested that the temperature and relative humidity sensors had frozen, creating invalid data; 3) Somewhat isothermal layers, as in this case, are not uncommon and represent valid data; and 4) If the temperature sensor had been "stuck", it would not have recovered as it did after ten minutes of flight.

tion: Monett, MO
roART Observation Program

Ascension: 706-1 Release: 23:10 22-NOV-92
Version 1.45 Print: 23:38 22-NOV-92

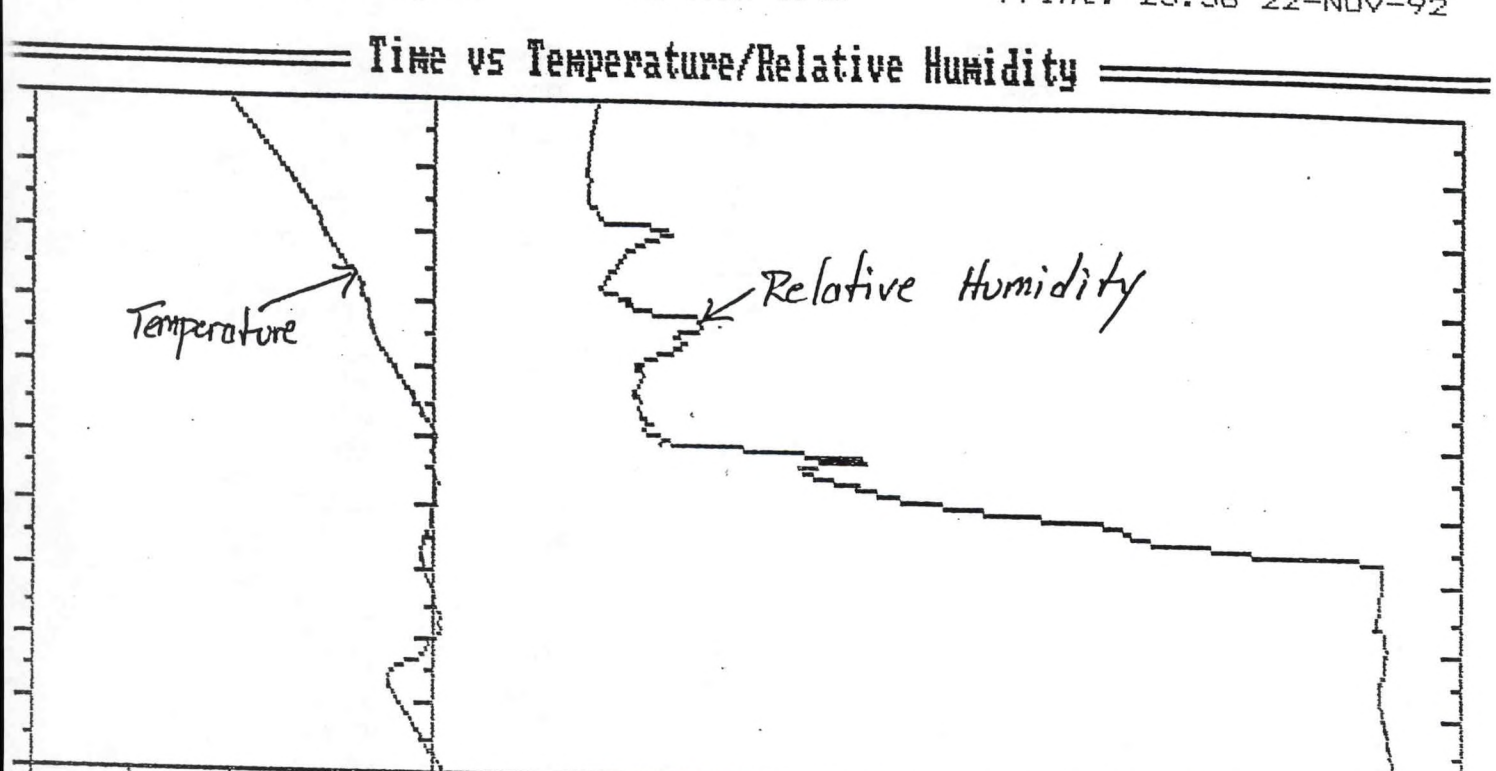

Figure 2. Plot of Time vs Temperature and Relative Humidity Ascension 706-1.

When multiple freezing levels are reported in a RADAT message, it is longer than the usual five digit number. In this case, the RADAT is rather complicated: 94L018053108/4. Decoded, this RADAT indicates that the highest humidity (94%) occurred at the lowest freezing level (94L), and that the lowest freezing level was at 1800 feet ASL (018), the highest was at 10,800 feet ASL (108), and an intermediate freezing level (with the highest relative humidity of the remaining freezing levels) was at 5,300 feet ASL (053). The slash 4 (/4) indicates that four other freezing levels were also detected. By looking at Table 2, the flight summary indicates each of the freezing levels with "FRZ" in the column labeled "reason." You will notice that only six are identified with "FRZ" and this is because one of the freezing levels occurred at 700 mb which is a mandatory level and has the word "MAND" in the reason column.

c. Case #3: An Incorrectly Flagged Humidity Sensor Failure

In this case, high humidities existed from 4.7 minutes to about 22 minutes of flight. Figure 3 displays the period of high humidities, and Table 3 indicates relative humidities in the upper 80's and 90's from minute 4.2 to 23.1. At 19.7 minutes, the MicroART program incorrectly stated that a relative humidity sensor failure had occurred at 4.7 minutes (Table 4).

Table 2 - Flight Summary Data for Ascension 706-1

Time(min)	P(mb)	Ht(M-MSL)	T(C)	RH(%)	DP(C)	DIR	SP	Reason
0.0	955.6	438	0.9	98	0.6	280	10	SFC
0.1	952.2	467	0.9	91	-0.5	281	11	RH
0.4	941.7	556	0.1	94	-0.8	283	12	FRZ
0.9	925.0	699	-1.1	94	-2.0	287	15	MAND
2.7	865.0	1231	-4.4	93	-5.4	316	20	TEMP
2.9	858.9	1287	-4.4	93	-5.4	321	21	TEMP
3.2	850.0	1369	-3.0	93	-4.0	325	23	MAND
3.4	844.9	1417	-1.6	93	-2.6	328	26	TEMP
4.0	828.0	1579	0.2	93	-0.8	335	33	FRZ
5.4	789.3	1963	0.0	93	-1.1	335	42	FRZ
6.5	759.0	2276	-1.3	93	-2.3	330	41	TEMP
7.9	723.7	2657	0.0	60	-6.9	316	37	FRZ
8.9	700.0	2924	0.0	39	-12.4	311	36	MAND
9.4	687.6	3067	-0.2	43	-11.3	310	36	RH
9.7	680.2	3154	-0.1	34	-14.2	310	36	FRZ
10.1	670.9	3264	0.0	22	-19.4	310	36	FRZ
12.8	608.5	4038	-5.5	25	-22.6	290	46	TEMP
13.5	593.6	4232	-6.3	26	-22.7	286	44	RH
14.4	575.2	4478	-6.9	20	-36.9	287	41	TEMP
16.1	538.9	4983	-10.9	23	-27.9	297	37	RH
16.5	531.3	5092	-11.4	20	-41.4	297	39	RH
18.2	500.0	5554	-15.3	20	-45.3			MAND

tation: Monett, MO
i[illegible]ART Observation Program

Ascension: 732-1 Release: 23:04 5-DEC-92
Version 1.45 Print: 23:44 5-DEC-92

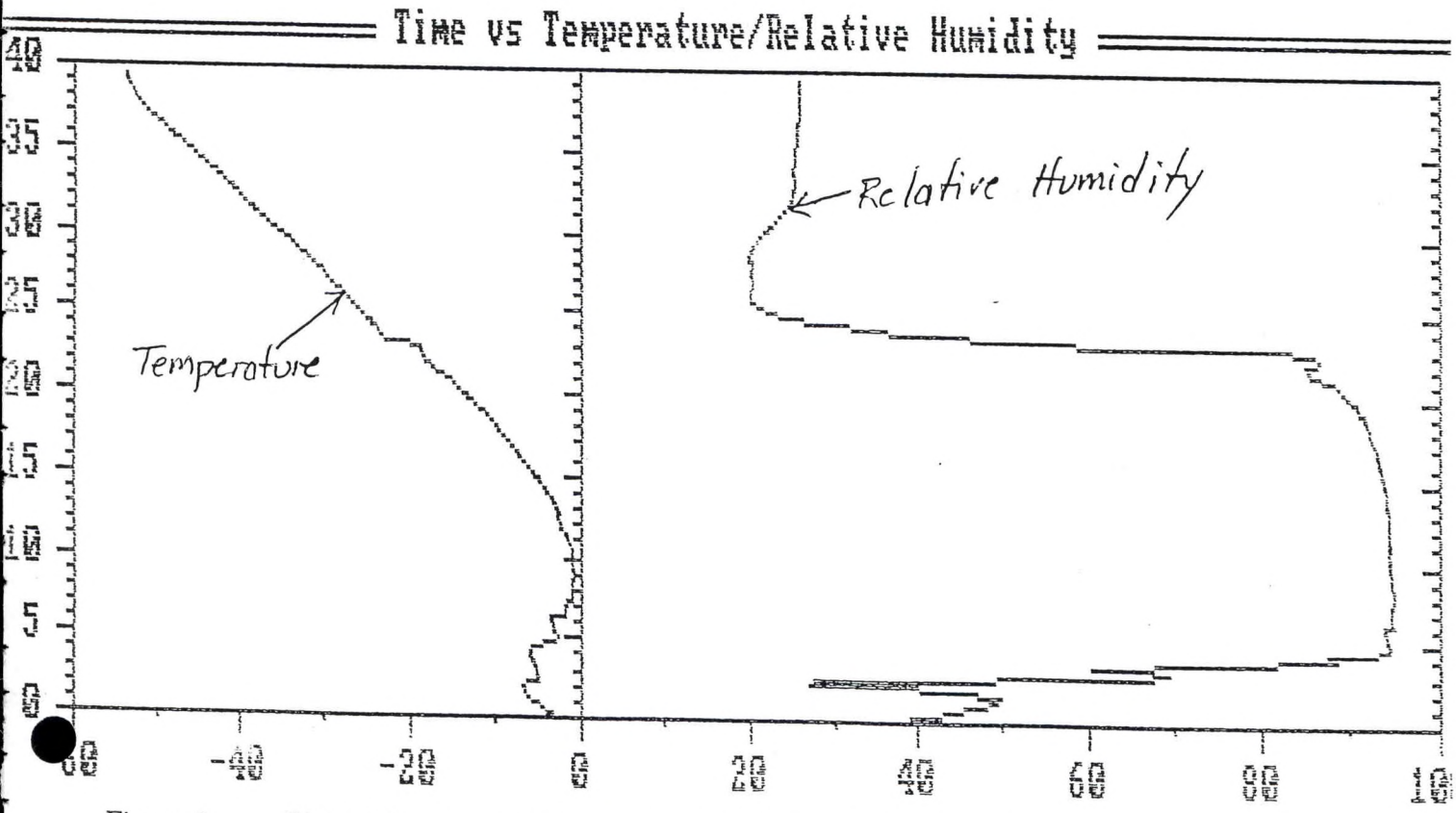

Figure 3. Plot of Time vs Temperature and Relative Humidity Ascension 732-1.

Table 3 - Flight Summary Data for Ascension 732-1

Time(min)	P(mb)	Ht(M-MSL)	T(C)	RH(%)	DP(C)	DIR	SP	Reason
0.0	976.0	438	-3.3	48	-12.8	0	0	SFC
0.1	972.9	463	-3.0	38	-15.4	15	0	TEMP
1.6	925.0	860	-6.6	49	-15.7	149	9	MAND
2.0	913.3	960	-6.6	44	-17.0	146	11	TEMP
2.3	904.1	1039	-4.9	27	-21.0	144	13	TEMP
2.5	898.4	1089	-5.0	30	-20.1	142	14	RH
2.8	889.7	1165	-5.0	62	-11.2	140	15	RH
3.2	878.1	1268	-5.3	69	-10.0	139	16	RH
3.5	869.5	1346	-5.6	60	-12.1	138	17	RH
4.2	850.0	1524	-5.7	88	-7.4	136	18	MAND
4.5	841.4	1604	-5.2	89	-6.8	136	19	TEMP
5.0	827.4	1736	-2.6	95	-3.4	134	21	TEMP
6.2	797.2	2031	-3.6	94	-4.5	142	20	TEMP
6.5	789.7	2106	-1.9	95	-2.7	152	19	TEMP
7.4	767.1	2338	-1.1	95	-1.9	184	16	TEMP
10.1	700.0	3069	-0.9	94	-1.7	233	19	MAND
14.0	611.0	4151	-3.8	94	-4.6	251	52	TEMP
19.5	500.0	5710	-12.5	91	-13.7	244	47	MAND
21.8	458.2	6371	-17.8	85	-19.7	248	50	TEMP
22.9	437.8	6711	-19.0	86	-20.8	250	57	TEMP
23.1	433.8	6779	-20.6	82	-22.9	250	59	RH
23.3	429.8	6848	-22.9	61	-28.4	251	61	TEMP
23.4	427.9	6880	-23.3	57	-29.5	251	62	TEMP
23.9	419.8	7020	-23.8	37	-34.4	253	66	RH
25.2	400.0	7371	-26.2	22	-41.5	254	66	MAND
28.2	358.2	8161	-31.6	20	-61.6	254	64	TEMP
32.1	308.7	9195	-40.0	25	-52.3	261	71	RHCUT
32.8	300.0	9390	-41.6	777	777.7	261	79	MAND
37.1	250.0	10601	-51.0	777	777.7	263	87	MAND
38.1	239.5	10879	-52.7	777	777.7	262	94	TEMP

Table 4 - Status Messages for Ascension 732-1

0.0	Balloon release detected.
3.4	Successful release.
19.7	RH sensor failure detected at 4.7 minutes.
25.7	Successful observation.
25.8	RADAT message has been generated.

This is a situation in which it would be easy to accept the diagnosis that the MicroART program presents. However, it is always best to investigate and determine if the data are correct. In this case the data are correct and the MicroART program is wrong for two reasons: 1) a relative humidity sensor would rarely recover from an open circuit (high humidity) condition to start indicating drier air (which requires conducting a current across the sensor), and 2) the WSR-57 radar at the same station indicated stratiform precipitation with uniform tops of 20,000 feet, which correlates well with the relative humidity profile in Figure 3.

3. Summary

Three soundings were presented, all of which contained valid data. The soundings included examples of 1) a very dry layer aloft, 2) a RADAT with seven freezing levels, and 3) an incorrectly flagged humidity sensor failure. The purpose of presenting these soundings was twofold: 1) to help the MicroART user (or any radiosonde user) recognize cases where valid data may be mistakenly discarded, and 2) to stress that it is best to investigate the sounding data and all warning messages to ensure their validity. Each of the cases were examined, and justifications were given for the validity of the data. Some methods that were used in the investigation process were 1) comparison with current and past synoptic patterns, 2) comparison with symptoms of sensor failure, and 3) correlating data with other sources, such as radar, surface observations or other soundings.