CHAPTER XIII. OFF-SITE OPERATIONAL DATA SETS

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A. INTRODUCTION

National Weather Service (NWS) operational date sets are available throughout and in between the three WASHITA'94 field campaigns of April 6-17, August 18-23, and October 1-6,1994. These data are important for atmospheric corrections to remote sensing data, computing water vapor budgets, assessing the atmospheric environment in terms of stability and synoptic forcing, and potentially for computing large-scale water and energy fluxes. This document will discuss only the operational sounding (or upper air) data sets which are most relevant to the atmospheric boundary layer. Other potential sources of atmospheric information include: GOES visible, infrared and water vapor products, National Meteorological Center (NMC) and European Center for Medium-range Weather Forecasting (ECMWF) assimilated fields, NEXt generation weather RADar (NEXRAD) fields, and the NWS Automated Surface Observing Stations (ASOS) and profiler networks. Most of these data are also available at the archive sites for the upper air data, which will be discussed later.

The closest operational sounding site to the Little Washita is Norman, Oklahoma (OUN). Sounding data from this location is archived for all the field campaign periods. Data from a nearby non-operational sounding site at the Army's Fort Sill, near Lawton, Oklahoma is not available in digital form, and “hard copies” are available for only the August and October campaigns. These sounding are generally launched at 0600 and 1100 local time. Other flights may be run Monday through Friday on an hourly basis as requested for ballistics applications. These ballistics flights are normally terminated at 700hPa. This data has not yet been obtained and will not be discussed in this document.

B. DATA DESCRIPTION

The base sounding dataset contains profiles of pressure, dry-bulb temperature, dew-point temperature, wind speed and direction at vertical sampling intervals six seconds apart from the ground surface through the troposphere. Additional quantities such as relative humidity, altitude, east-west (u) and north-mouth (v) wind components, ascension rate, longitude, latitude, elevation angle, and azimuth angle are available for all of the data archived in the UCAR/Office of Field Project Support (UCAR/OFPS) CLASS Format (OCF).

The OCF is an ASCII format consisting of 15 header records for each sounding followed by the data records with associated quality control (QC) information. This format is outlined in Tables XIII-la through 1c. The header records contain data type, project ID, site ID, site location, release time and ascension number. The data records contain time from release, pressure, temperature, dew-point, relative humidity, U and V wind components, wind speed and direction, ascent rate, balloon position data, altitude, and quality control flags. The QC process includes “reasonable” limit checks on all parameters and rate-of-change checks on temperature, pressure and ascension rate.

The NWS rawindsonde network soundings are nominally released at 00 and 12 UTC, which corresponds to actual release times of 23 UTC (18 CDT) the previous day and 11UTC (06 CDT), respectively. Thus, the part of the sounding containing the atmospheric boundary layer (ABL) corresponds more closely to the actual launch time than to the nominal launch time. Figure XIII-1 shows the network stations in the vicinity of the Little Washita, whose approximate location is also shown. Table XIII-2 lists the station IDs, WBAN codes, latitudes, longitudes and elevations of the sounding archive stations.

1. April Campaign

VORTEX. During the period 1 April - 15 June 1994, 6-second NWS sounding data was extracted from the NWS Micro-ART sounding system and archived for 12 sites within a region extending from 91W to 107W longitude and 31N to 40N latitude (as shown in Figure XIII-1) as part of the Verification of the Origins of Rotation in Tornadoes EXperiment (VORTEX). This experiment was/will be held in the central and southern Plains of the US during the spring seasons of 1994 and 1995 to investigate tornadogenesis and tornado dynamics. (For more information about the experiment, contact: Erik N. Rasmussen, Meteorologist, NOAA/NSSL, 1313 Halley Circle, Norman, OK 73069, Phone: (405) 366-0520, E-mail: me@blackbox.nssl.uoknor.edu). As part of this experiment, special 10-second NCAR/CLASS soundings, such as those described in Chapter XII of this document, were obtained at various locations within the VORTEX domain. In addition, special soundings at the NWS operational sites were conducted on an as requested basis--particularly at Norman OK (OUN). These additional date are also available, but will not be discussed here.

The NWS soundings during VORTEX were comprised of two types: Space Data radiosondes (Amarillo, El Paso, Midland and Stephenville TX and Albuquerque NM) and VIZ radiosondes (Denver CO, Dodge City KS, Little Rock AR, Longview TX, Monett MO, Norman OK, Topeka KS, Albuquerque NM, and Stephenville TX). Albuquerque NM and StephenvilleTX both used Space Date radiosondes from 01 April to 31 May 1994. They both switched to VIZ radiosondes from 01 June and thereafter.

GIST. Simultaneous with the VORTEX project was the GCIP [GEWEX (Global Energy and Water Cycle Experiment) Continental-Scale International Project] Integrated Systems Test (GIST) conducted from 01 April to 31 August 1994. The GIST domain extends from 85W to 115W longitude and 30N to 40N The GIST includes 12 NWS sounding stations as shown in

Figure XIII-1 and listed in Table XIII-2. As shown on the Figure and Table, the Stephenville, TX site moved to Fort Worth, TX on 09 July 1994. The final data set consists of 6-second vertical resolution soundings.

Quality control. The following information is taken from the documents “VORTEX National Weather Service High-Resolution Upper-Air Datatset" and “GIST National Weather Service High-Resolution Upper-Air Dataset”, which are available with the date, as described in Section C. Data Acquisition. Any further questions about the dab QC algorithms should be addressed to Jose Meitin, Meteorologist NOAA/NSSL, N/C/MRD, 325 Broadway, Boulder, CO 80303-3328. Phone: 303-497-8168. E-mall: meitin@ofps.ucar.edu.

In addition to the QC flags in the CLASS format, a second-stage QC process consisting of visual examination of highly variable parameters such as wind speed, wind direction and moisture was applied to all VORTEX and GIST sounding data. At this time, the QC flags themselves were also visually verified.

The OFPS applied a correction to the Space Data radiosonde relative humidity calculations. This correction was necessary due to an error in the NWS Micro-ART sounding system, in which the observed temperature was erroneously divided by 100 in the resistance ratio and relative humidity calculations. The OFPS correction iteratively rederived the resistance ratio using observed temperature and observed RH to obtain the so-called "1A" and "1B" coefficients . The RH was then recalculated using the new resistance ratio, observed temperature and "1A" coefficient only.

A similar correction to the VIZ radiosonde RH was applied using observed temperature and "lA" coefficient only. In both radiosonde types, the raw 6-second elevation and azimuth data used to derive the winds sometimes led to large oscillations in wind speed, due to oscillations in elevation angle data, particularly at low elevation angles. The general approach to correct this problem was to remove the outlier radiosonde position data before computing the wind components. For both the azimuth and elevation angles from 360 seconds to the end of the sounding, a ninth order polynomial was fit to the curve. The residuals were calculated and compared to the observed values. The outliers of the residuals were then removed.

To help correct the more extensive problems at low elevation angles within 10 degrees of the limiting angles (LA) some additional smoothing was applied. If the elevation angle was between (LA + 7.5) and (LA + 10), the new elevation angle was computed with a 2 minute linear fit. If the elevation angle was between (LA + 5) and (LA + 7.5) the new elevation angle was computed with a 3 minute linear fit. If the elevation angle was less than (LA + 5), the new elevation angle was computed with a 4 minute linear fit. If the number of observations with low elevation angles was greater then 20% of the total number of observations for the sounding no frequency smoothing occurred.

In addition, for elevation angle only, a finite Fourier analysis was performed on the residuals. Periods from 90-190 seconds were removed and those below 30 seconds were flattened.

Finally, a 2 minute second order polynomial was then fit to the position to derive the u and v wind components, except for the beginning and end minute (or 1.5 minutes if over 50 mb) which used a 3 minute fit. If there were less than 15% of the total number of points, not counting the beginning or end of the flight, on one side of the point for which the wind value was being computed, a linear fit was used.

Examples of the Norman, Oklahoma 1200 UTC sounding on April 6,1994 are given in Figures XIII-2a through 2c. Figure XIII-2a shows the temperature sounding, XIII-2b the humidity, and XIII-2c the winds. The surface layer and inversion base are clearly discernable on Figure XIII-2a, as well as the presence of a cloud layer, which is also evident from Figure XIII-2b. Figure XIII-2c shows the low-level jet at approximately 1500 meters. This feature is most clearly seen on the 1200 UTC soundings which correspond to an actual launch time of approximately 0600 CDT.

2. August Campaign

The August campaign falls within the GIST period; therefore, the data available for August are the same as for the April period.

Examples of the Norman, Oklahoma 0000 UTC sounding on August 20,1994 are given in Figures XIII-3a through 3c. Figure XIII-3a shows the temperature sounding, XIII-3b the humidity, and XIII-3a the winds. The temperature sounding again shows the inversion base, which is markedly higher than that in Figure XIII-2a, which was a morning sounding. The surface layer is not as apparent in this sounding, owing to the absence of an inversion near the ground surface. The relative humidities are much less than for the April sounding, and tend to increase with height above the boundary layer, as opposed to the decrease observed in Figure XIII-2b. The wind speeds are overall much less in August than in April, and the presence of the jet is not readily determined.

3. October Campaign

The October data are currently only available from the OFPS/CODIAC and/or the NCDC sounding archive. This archive contains only the basic sounding data: pressure, height, temperature, relative humidity, wind direction and wind speed. These data have undergone hydrostatic consistency checks, and are only archived at “mandatory and significant levels”. The sparseness of this data compared to the 6-second NWS soundings is apparent by comparing Figures XIII-2a through c and XIII-3a through c with Figures XIII-4a through c.

Examples of the Norman, Oklahoma 1200 UTC sounding on October 1, 1994 are given in Figures XIII-4a through 4c. Figure XIII-4a shows the temperature sounding, XIII-4b the humidity, and XIII-4c the winds. The temperature sounding again indicates the morning inversion near the ground. However, the inversion base is somewhat difficult to identify at this resolution. The relative humidities near the ground are rather high, possibly as a consequence of dew formation and the inversion, but reduce dramatically above 2000 meters, which probably corresponds to an elevated mixed layer from the previous day. The wind sounding indicates some sort of jet very close to the ground, but the resolution through the mixed layer is generally poor compared to the 6-second soundings.

C. DATE ACQUISITION

Operational sounding data for the Washita'94 experiment can be obtained electronically free-of-charge via the World Wide Web (WWW) using Mosaic or via telnet to the CODIAC system.

The starting point for WWW is:

http://www.ofps.ucar.edu/codiac-www.html

Using telnet, the commands are:

telnet codiac.ofps.ucar.edu or telnet hurricane.ncdc.noaa.gov
username: storm
password: research

1. April and August Campaigns

On the WWW, select the hypertext for searching via a specific research program of field project. Under the heading “OFPS Field Projects” you will find both the GIST and VORTEX projects. Follow the instructions to obtain a fill-out form for ordering the data.

With telnet you may use either the X-windows interface or an ASCII interface to order the data.

2. October Campaign

The October data can be obtained via WWW or telnet using “search by space and time” options.

D. REFERENCES

Micro-ART Observation and Rework Programs Technical Document, National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC, March 1991.

Williams, S.F., C.G. Wade, and C. Morel, 1993: A comparison of high resolution radiosonde winds: 6-second Micro-ART winds versus 10-second CLASS LORAN winds. Preprints, Eighth Symposium on Meteorological Observations and Instrumentation, Anaheim, CA, Amer. Meteor. Soc., 60-65.

Table XIII-la: Description of the 15-line UCAR/OFPS CLASS Format Header.

CLASS Header

Line	Data Type	Example
1	Data Type:	National Weather Service Sounding
2	Project ID:	0
3	Launch Site Type/Site ID:	ABQ Albquerque, NM
4	Launch Location (lon,lat,alt):	106 36.00'W 35 00.00'N, -106.6, 35.0, 1615
5	GMT Launch Time (y,m,d,h,m,s):	1994, 04, 28, 11:03:00
6	Ascension No:	1234
12	GMT Nominal Launch Time (y,m,d,h,m,s):	1994, 04, 28, 12:00:00
13	Column Names	Time Press. Temp Dewpt RH...
14	Column Units	sec mb C C %...
15	Underscores	__,___ ___, ___ _..

Table XIII-lb: Description of the ASCII CLASS data format.

CLASS Data

Field	Width	Format	Parameter		Units
1	6	F6.1	Time	Seconds	9999.0
2	6	F6.1	Pressure	Millibars	9999.0
3	5	F5.1	Dry-bulb Temperature	Degrees C	999.0
4	5	F5.1	Dew Point Temperature	Degrees C	999.0
5	5	F5.1	Relative Humidity	Percent	999.0
6	6	F6.1	U Wind Component	Meters/Second	9999.0
7	6	F6.l	V Wind Component	Meters/Second	9999.0
8	5	F5.1	Wind Speed	Meters/Second	999.0
9	5	F5.l	Wind Direction	Degrees	999.0
10	5	F5.1	Ascension Rate	Meters /Second	999.0
11	8	F8.3	Longitude	Degrees	9999.0
12	7	F7.3	Latitude	Degrees	999.0
13	5	F5.1	Elevation Angle	Degrees	999.0
14	5	F5.1	Azimuth Angle	Degrees	999.0
15	7	F7.1	Altitude	Meters	99999.0
16	4	F4.1	QC for Pressure	Code (see XIII-1c)	99.0
17	4	F4.1	QC for Temperature	Code (see XIII-1c)	99.0
18	4	F4.1	QC for Humidity	Code (see XIII-1c)	99.0
19	4	F4.1	QC for U Component	Code (see XIII-1c)	99.0
20	4	F4.1	QC for V Component	Code (see XIII-1c)	99.0
21	4	P4.1	QC for Ascension Rate	Code (see XIII-1c)	99.0

Table XIII-1c: Description of the CLASS Quality Control Codes.

Quality Control Codes	
Code	Description
99.0	Unchecked (QC information is “missing”) ('UNCHECKFD')
1.0	Checked, datum seems physically reasonable. ('GOOD')
2.0	Checked, datum seems questionable on physical basis. ('MAYBE')
3.0	Checked, datum seems to be in error. ('BAD')
4.0	Checked, datum is interpolated. ('ESTIMATED')
9.0	Checked, datum was missing in original file. ('MISSING')

Table XIII-2: Names and locations of VORTEX and GIST sounding archive stations.

ID	WBAN	Station Name	Longitude (ddd mm.mm)	Latitude (ddd mm.mm)	Elevation (m)
ABQ	72365	ALBUQUERQUE, NM	106 36.00'W	35 00.00'N	1615.00
AMA	72363	AMARILLO, TX	101 42.00'W	35 12.00'N	1094.00
DDC	72451	DODGE CITY, KS	100 00.00'W	37 48.00'N	790.00
DEN	72469	DENVER,CO	104 54.00'W	39 48.00'N	1611.00
ELP	72270	EL PASO, TX	106 24.00'W	31 48.00'N	1199.00
FWD*	72260**	FORT WORTH, TX**	097 06.00'W	32 06.00'N	198.00
OGG	72247	LONGVIEW, TX	094 42.00'W	32 18.00'N	124.00
LIT	72340	NORTH LITTLE ROCK, AR	092 18.00'W	34 48.00'N1	72.00
MAF	72265	MIDLAND, TX	102 12.00'W	32 00.00'N	873.00
OUN	72357	NORMAN, OK	097 24.00'W	35 12.00'N	357.00
SEP*	72260	STEPHENVILLE, TX	098 12.00'W	32 12.00'N	399.00
TOP	72456	TOPEKA,KS	095 36.00'W	39 06.00'N	270.00
UMN	72349	MONETT, MO	093 54.00'W	36 54.00'N	438.00

*Note that SEP is a VORTEX station only and on 9 July 1994 was moved to FWD, which is the corresponding GIST station. The WBAN number and station name for FWD have not been verified.

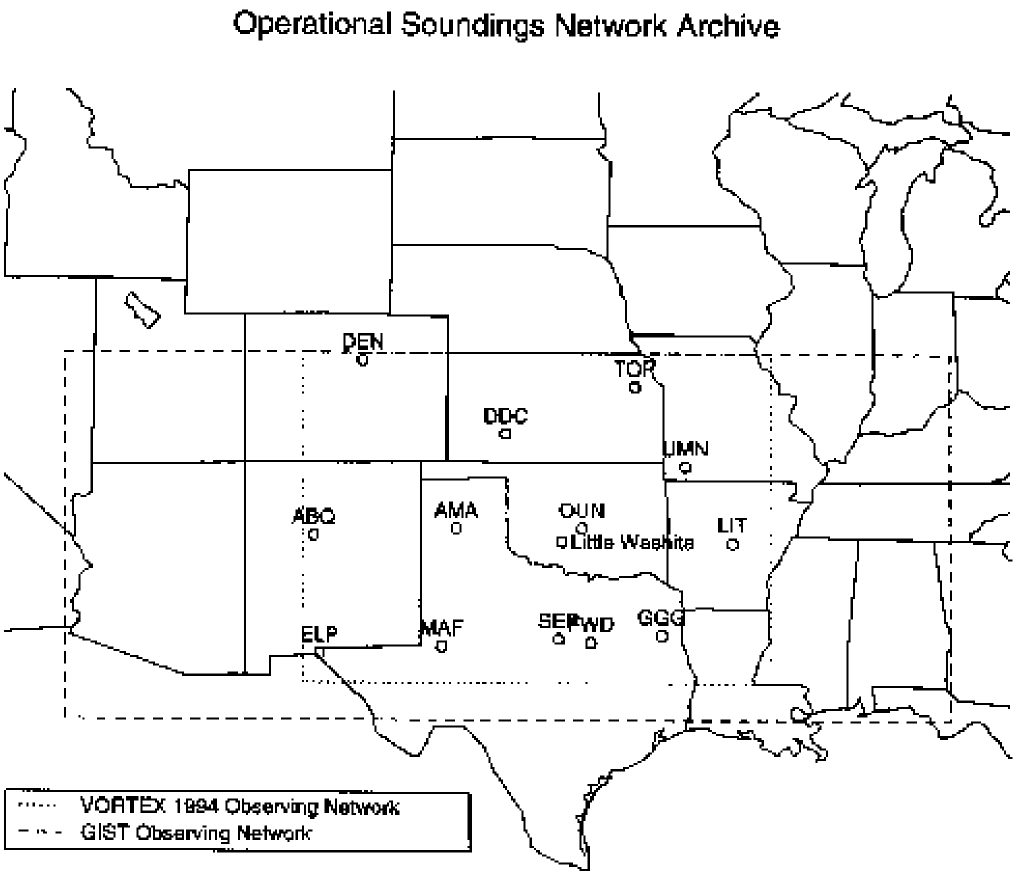

Figure XIII-1. Location of operational upper air sounding locations in the vicinity of the Little Washita river Watershed. Boxes show extent of the VORTEX and GIST data archival regions

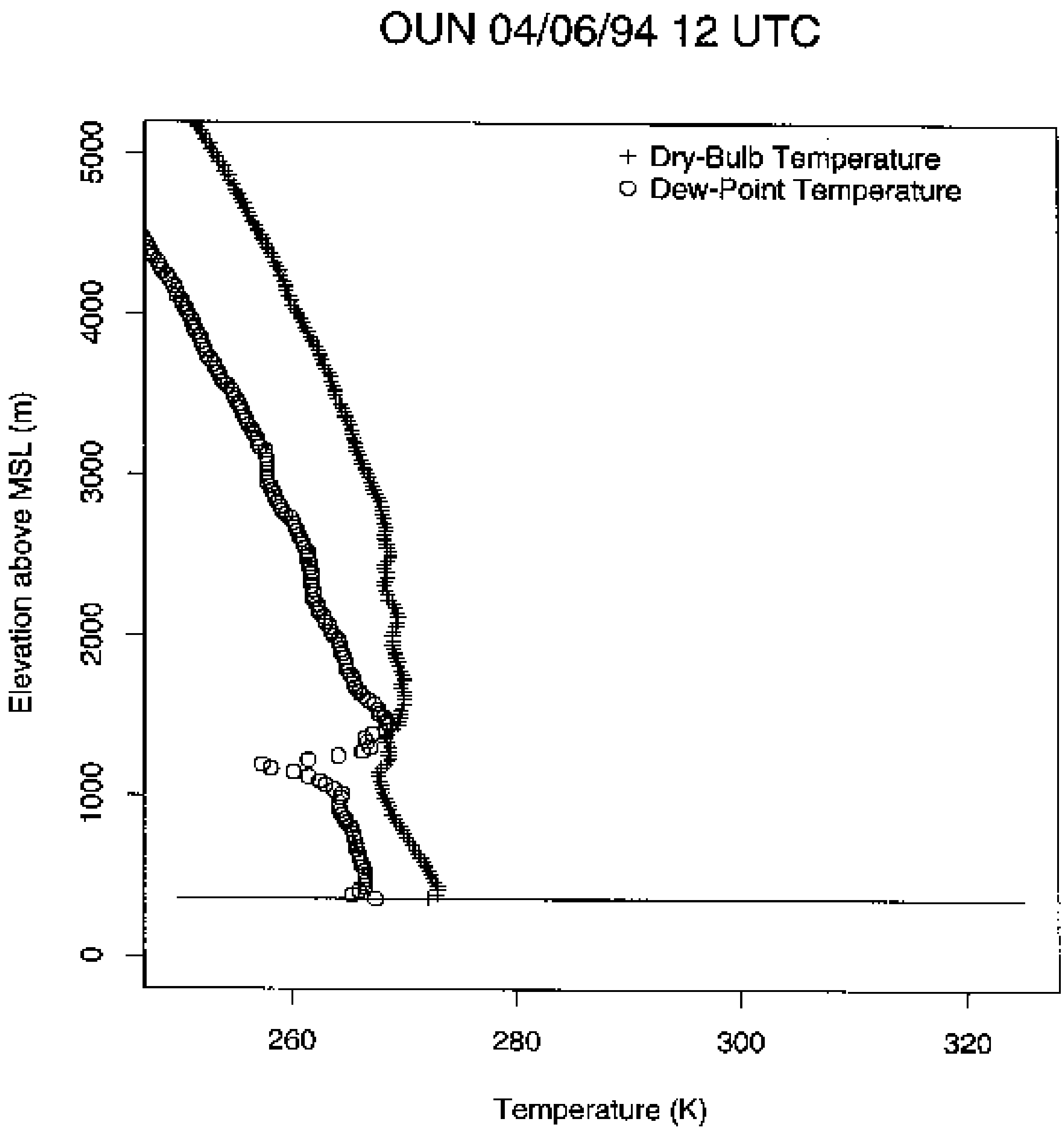

Figure XIII-2a. Temperature sounding at Norman, Oklahoma (OUN), April 6, 1994 at 1200 UTC nominal launch time. Note that 1200 UTC nominal launch time typically corresponds to an 1100 UTC or 0600 CDT actual launch time. Horizontal line indicated station elevation of 357 meters.

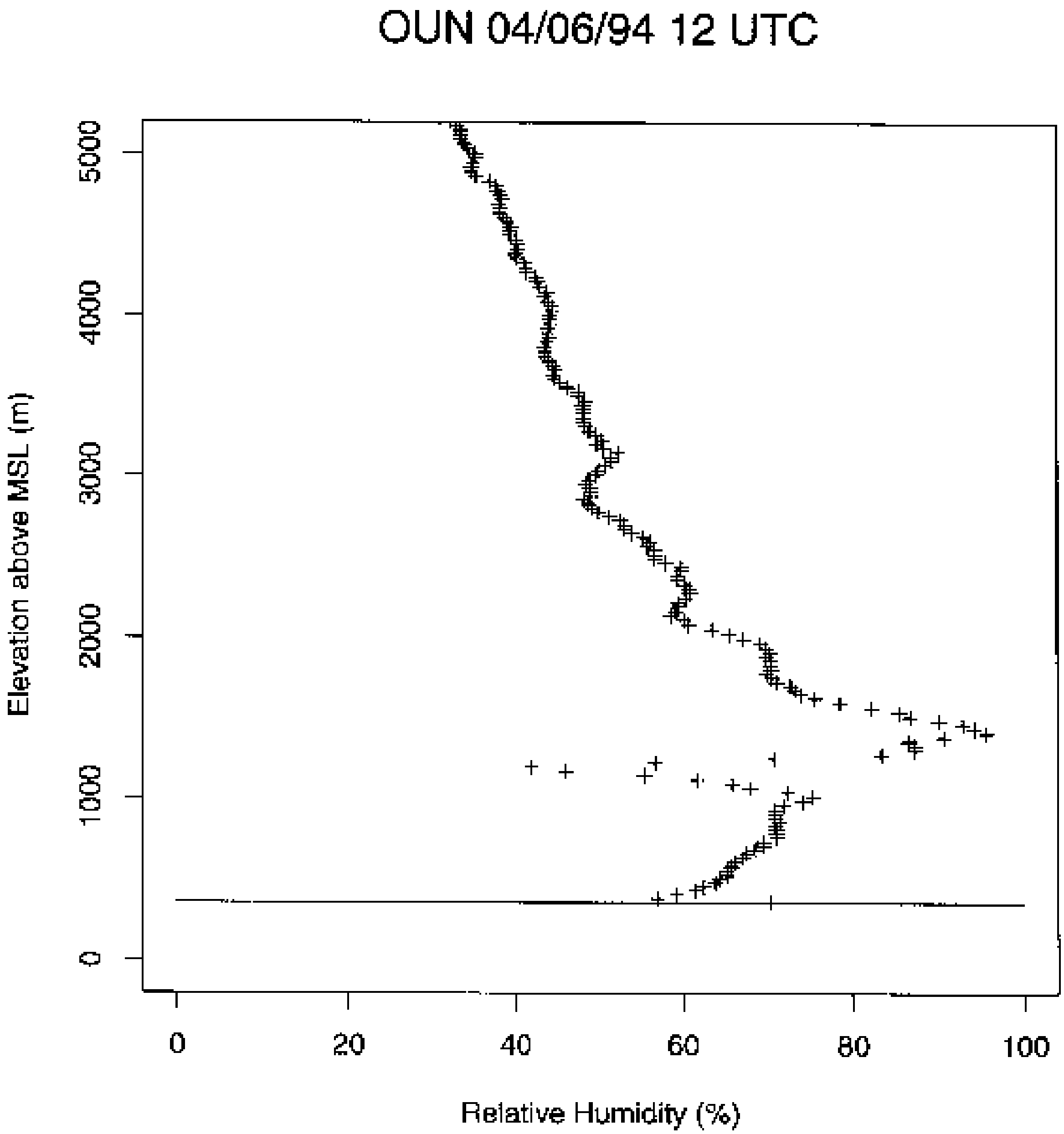

Figure XIII-2b. Same as Figure XIII-2a but for relative humidity.

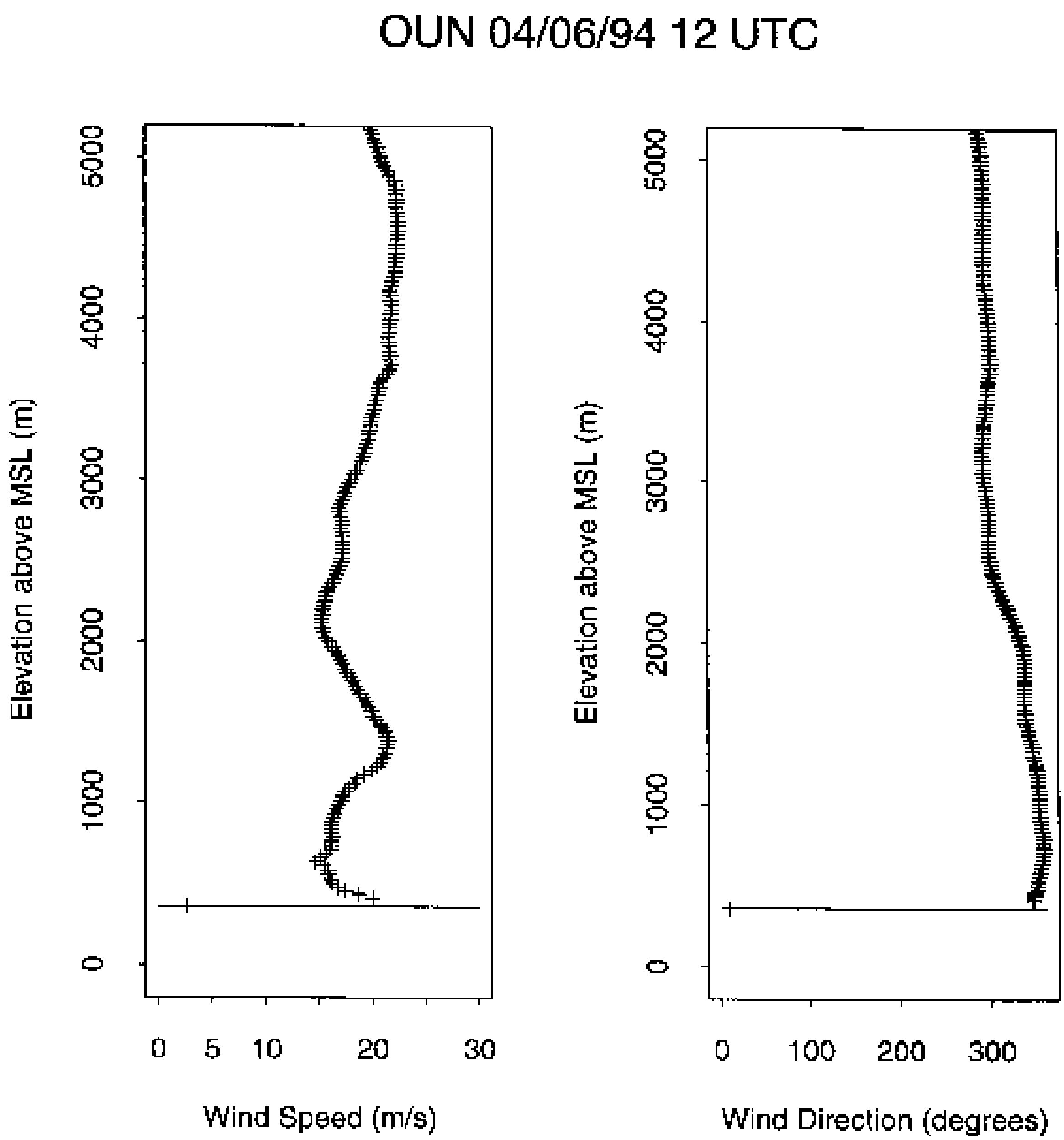

Figure XIII-2c. Same as Figure XIII-2a but for wind speed and direction in degrees clockwise from north.

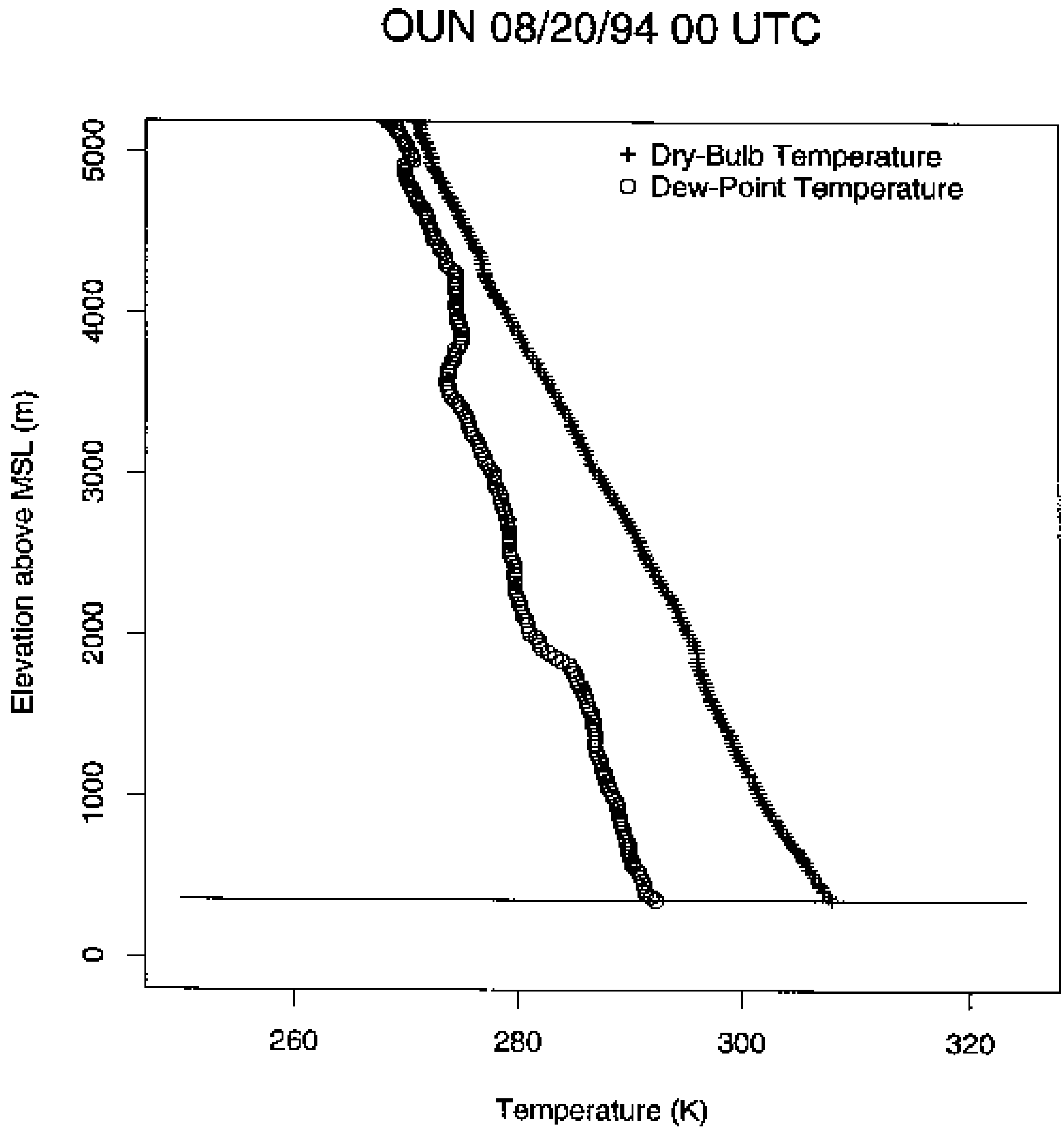

Figure XIII-3a. Temperature sounding at Norman, Oklahoma (OUN), April 6, 1994 at 0000 UTC nominal launch time. Note that 0000 UTC nominal launch time typically corresponds to a 2300 UTC or 1800 CDT actual launch time. Horizontal line indicated station elevation of 357 meters.

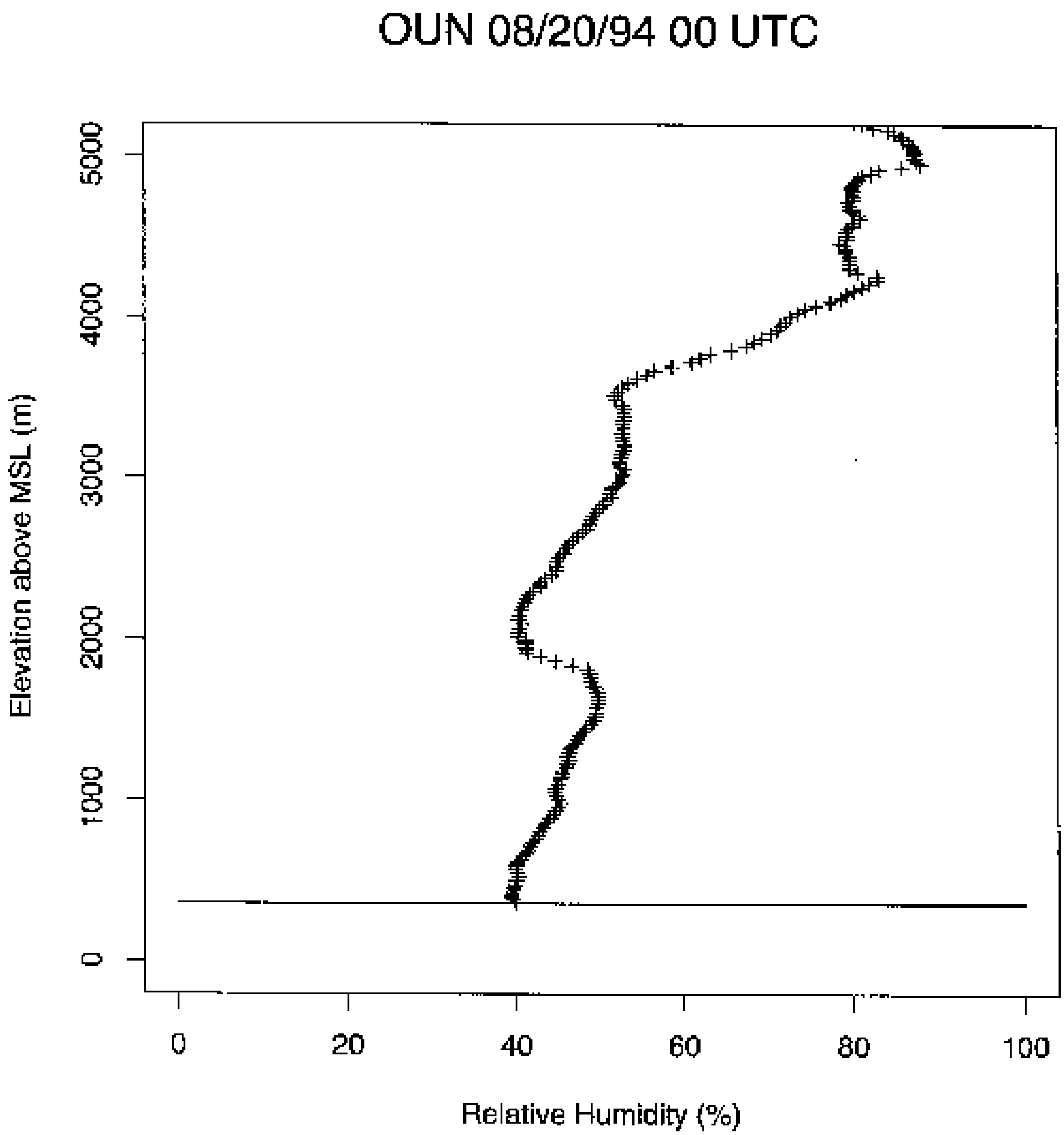

Figure XIII-3b. Same as Figure XIII-3a but for relative humidity.

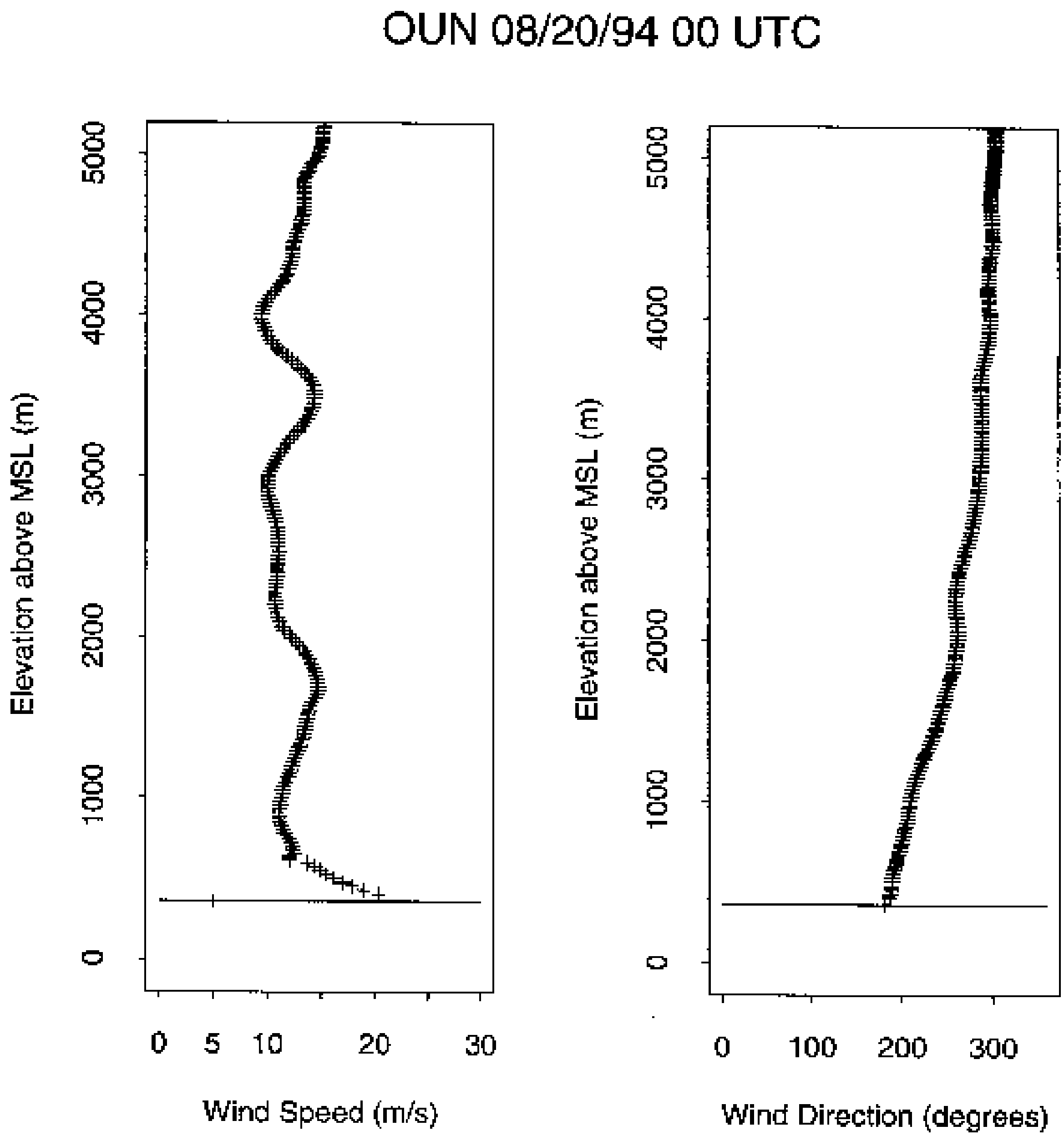

Figure XIII-3c. Same as Figure XIII-3a but for wind speed and direction in degrees clockwise from north.

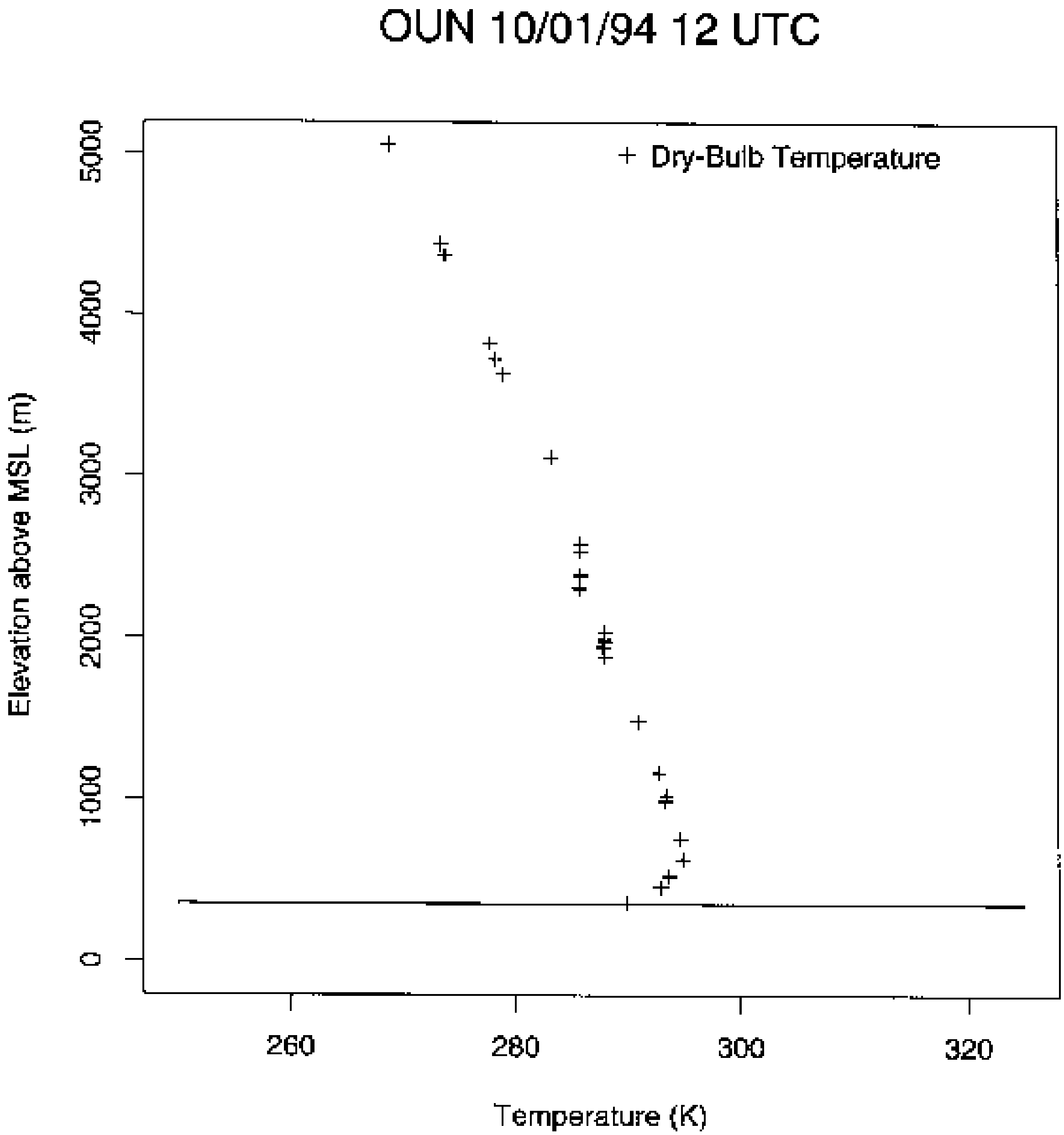

Figure XIII-4a. Temperature sounding at Norman, Oklahoma (OUN), October 1, 1994 at 1200 UTC nominal launch time. Note that 1200 UTC nominal launch time typically corresponds to an 1100 UTC or 0600 CDT actual launch time. Horizontal line indicated station elevation of 357 meters.

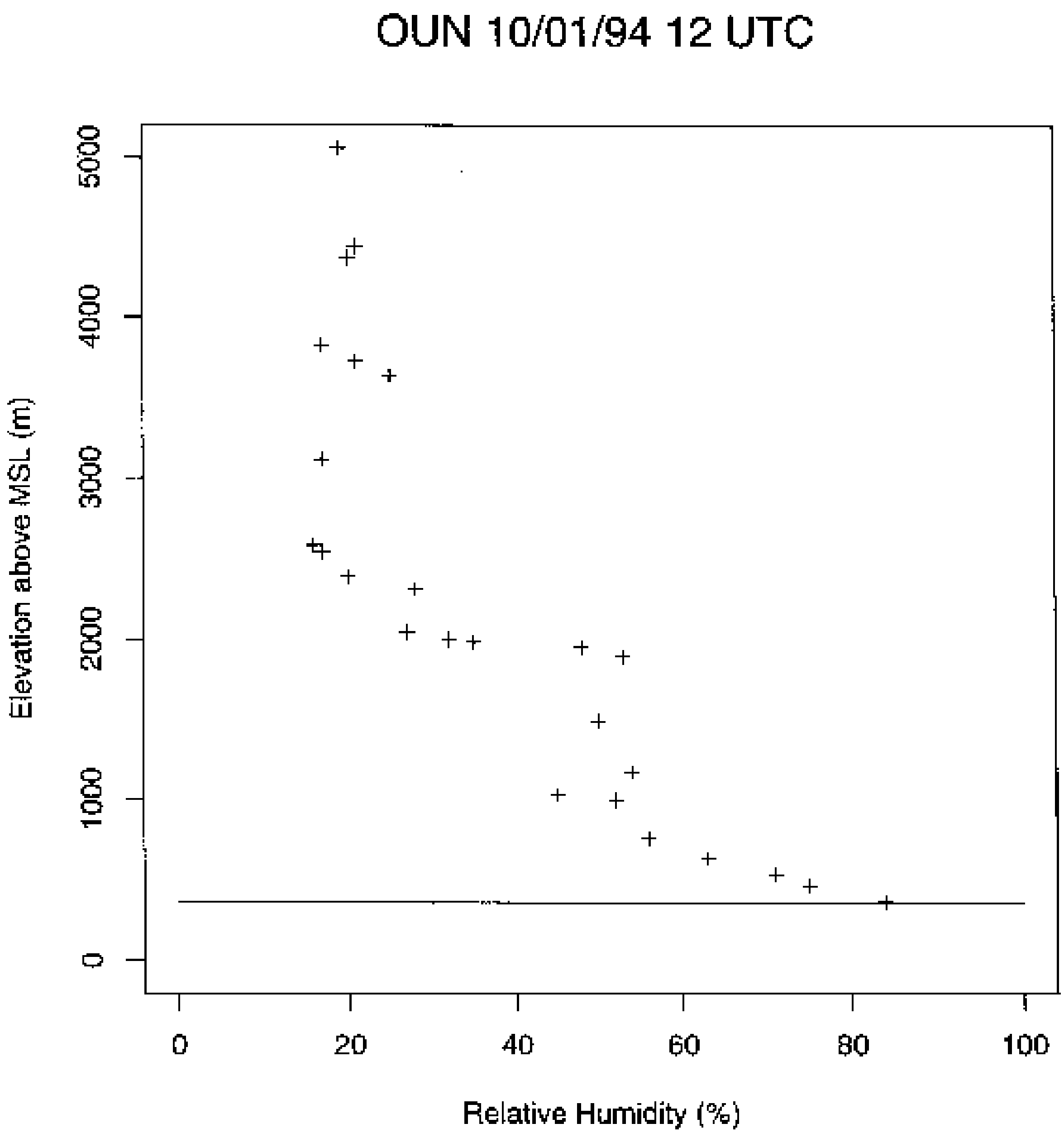

Figure XIII-4b. Same as Figure XIII-4a but for relative humidity.

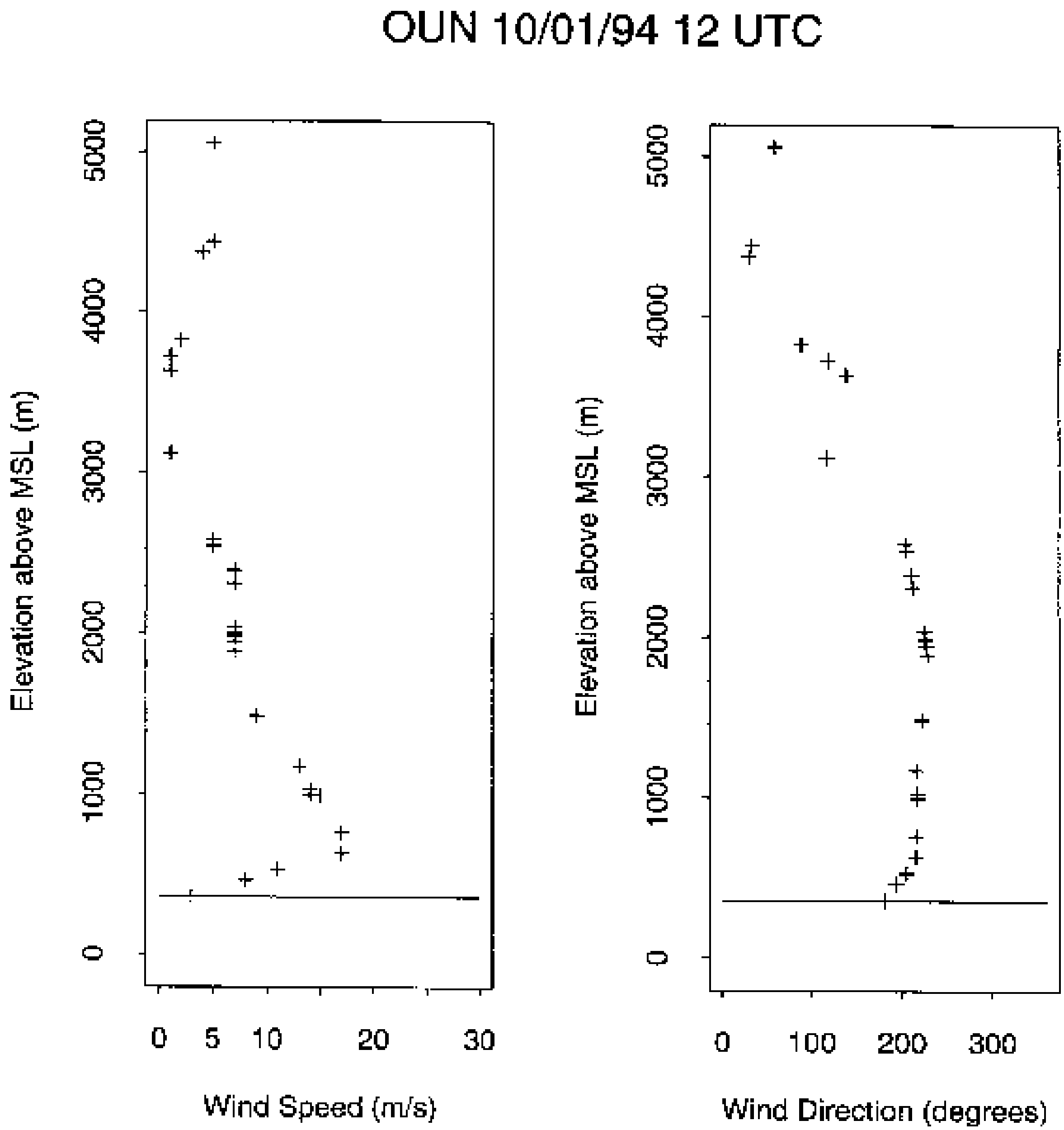

Figure XIII-4c. Same as Figure XIII-4a but for wind speed and direction in degrees clockwise from north.