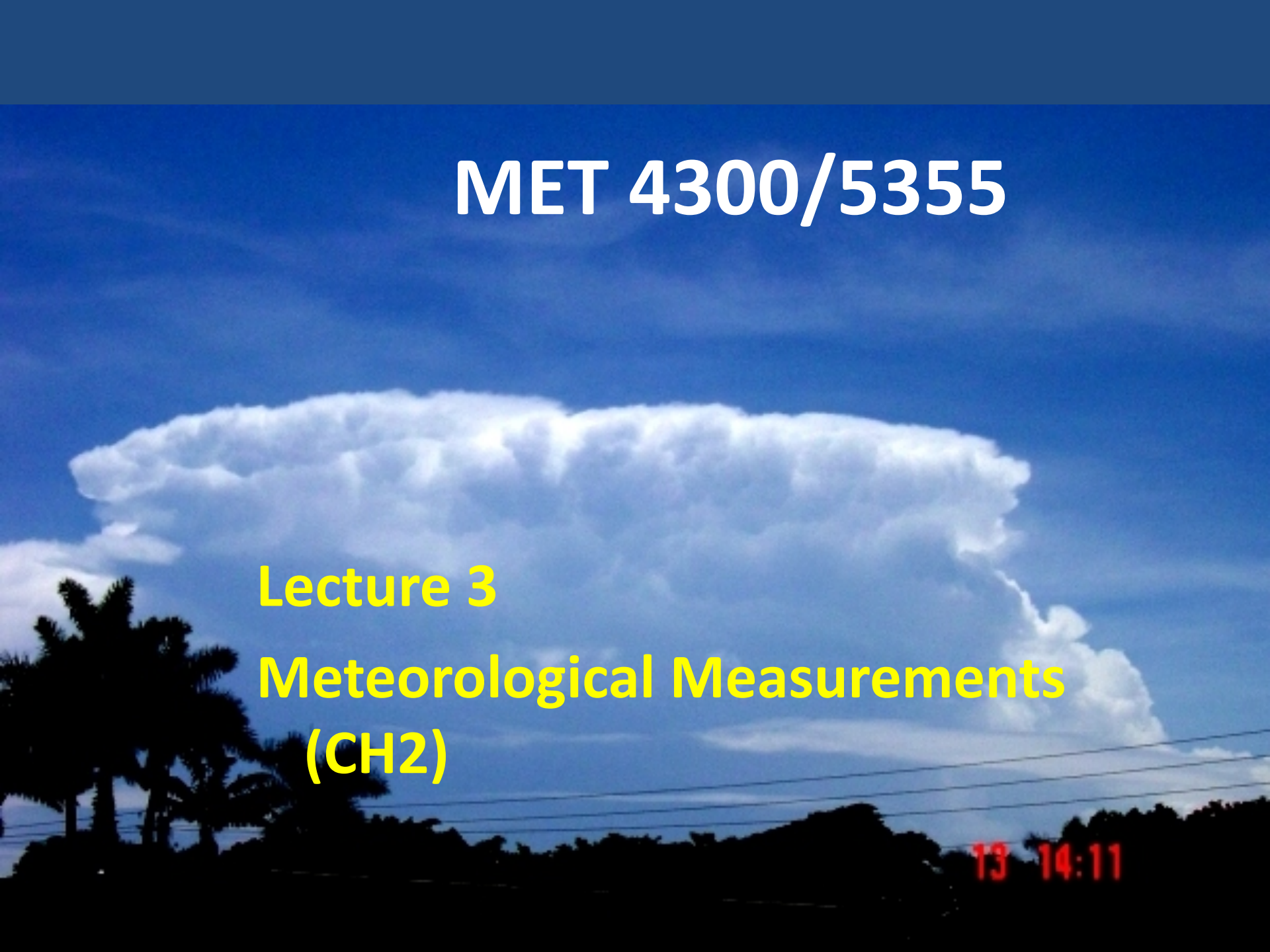


MET 4300/5355

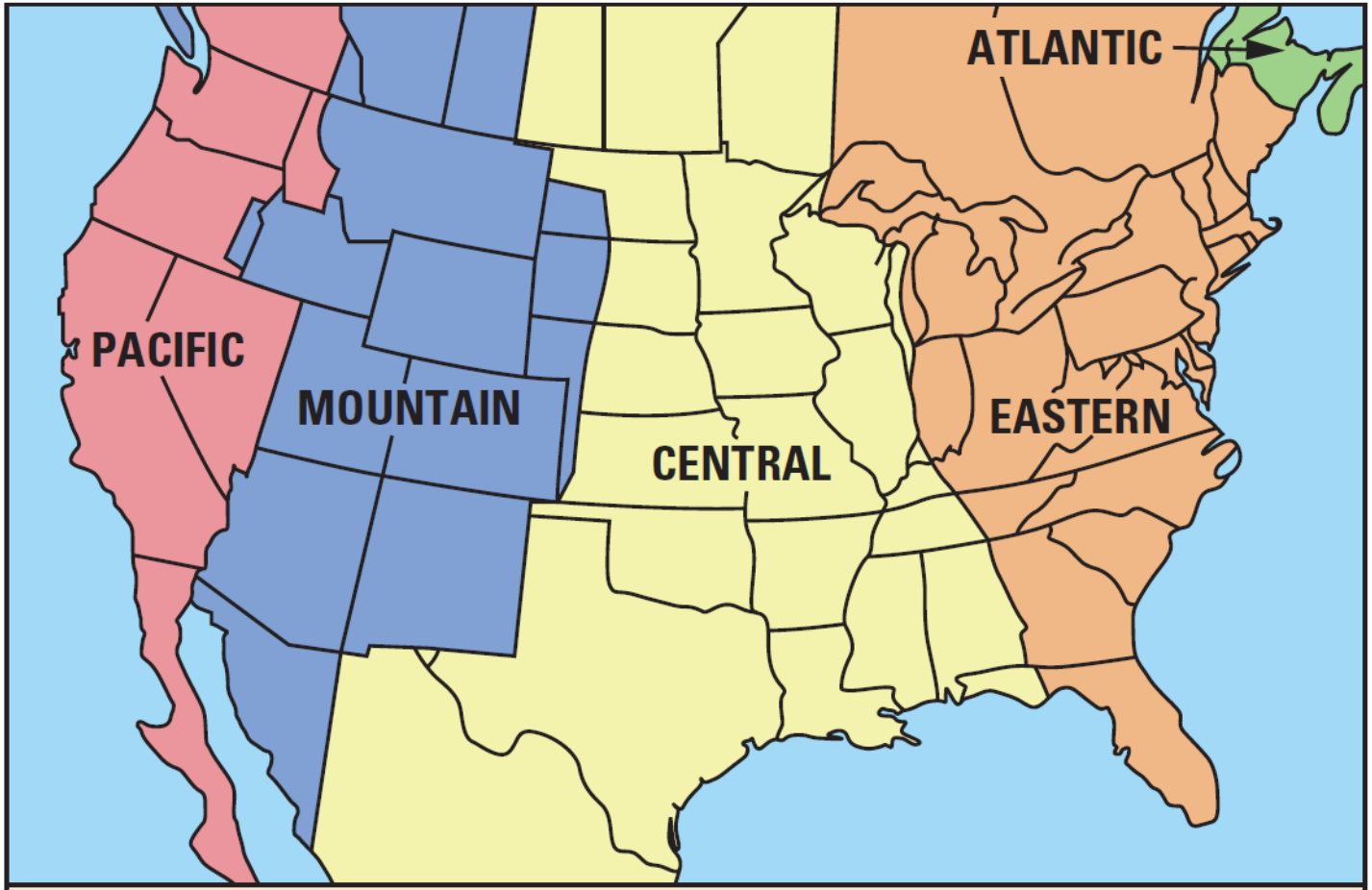
Lecture 3

Meteorological Measurements (CH2)

Time Conversions

- Meteorological observations are **simultaneously**: synoptic observations
- Universal Coordinate Time (UTC): Greenwich Mean Time (GMT), Zulu (Z)
- Miami standard (UTC-5hours) local time=UTC-5 hours; Miami daylight local time=UTC-4 h

STD (Daylight))		Pacific UTC-8 (-7)	Mountain UTC-7 (-6)	Central UTC-6 (-5)	Eastern UTC-5 (-4)
1200 UTC	STD	4 am	5 am	6 am	7am
	Daylight	5 am	6 am	7 am	8 am
0000 UTC	STD	4 pm	5 pm	6 pm	7 pm
	Daylight	5 pm	6 pm	7 pm	8 pm



		Pacific	Mountain	Central	Eastern	Atlantic
1200 UTC	STANDARD	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.
	DAYLIGHT	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.
0000 UTC	STANDARD	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.
	DAYLIGHT	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.

Surface Measurements

- Automated weather stations: north American, continuously measurements, reported hourly
- Worldwide: non-automated measurements: 3 hourly
- In the US:
  - Automated Surface Observing Systems (ASOS) from NWS
  - Automated Weather Observing Systems (AWOS) from Federal Aviation Admin. (FAA) and DoD
  - ASOS and AWOS work nonstop, report data hourly, available via Internet

ASOS and AWOS

- 600 Sites, FAA, NWS, MIL, …
- Report hourly:
- Wind speed, direction, and gusts
- Temperature and dew point
- Cloud height and coverage
- Visibility
- Present weather (rain, drizzle, snow)
- Rain accumulation
- Thunderstorms and lightning
- Altimeter (pressure)
- Fog, mist, haze, freezing fog

ASOS Instruments

- Tipping Bucket Rain Gauge

- Hygrothermometer (RH & T)

ASOS Instruments

- Freezing Rain Sensor

- Ceiliometer: measure cloud base height & aerosol concentration

ASOS Instruments

- Wind Vane and anemometer

- Thunderstorm Sensor

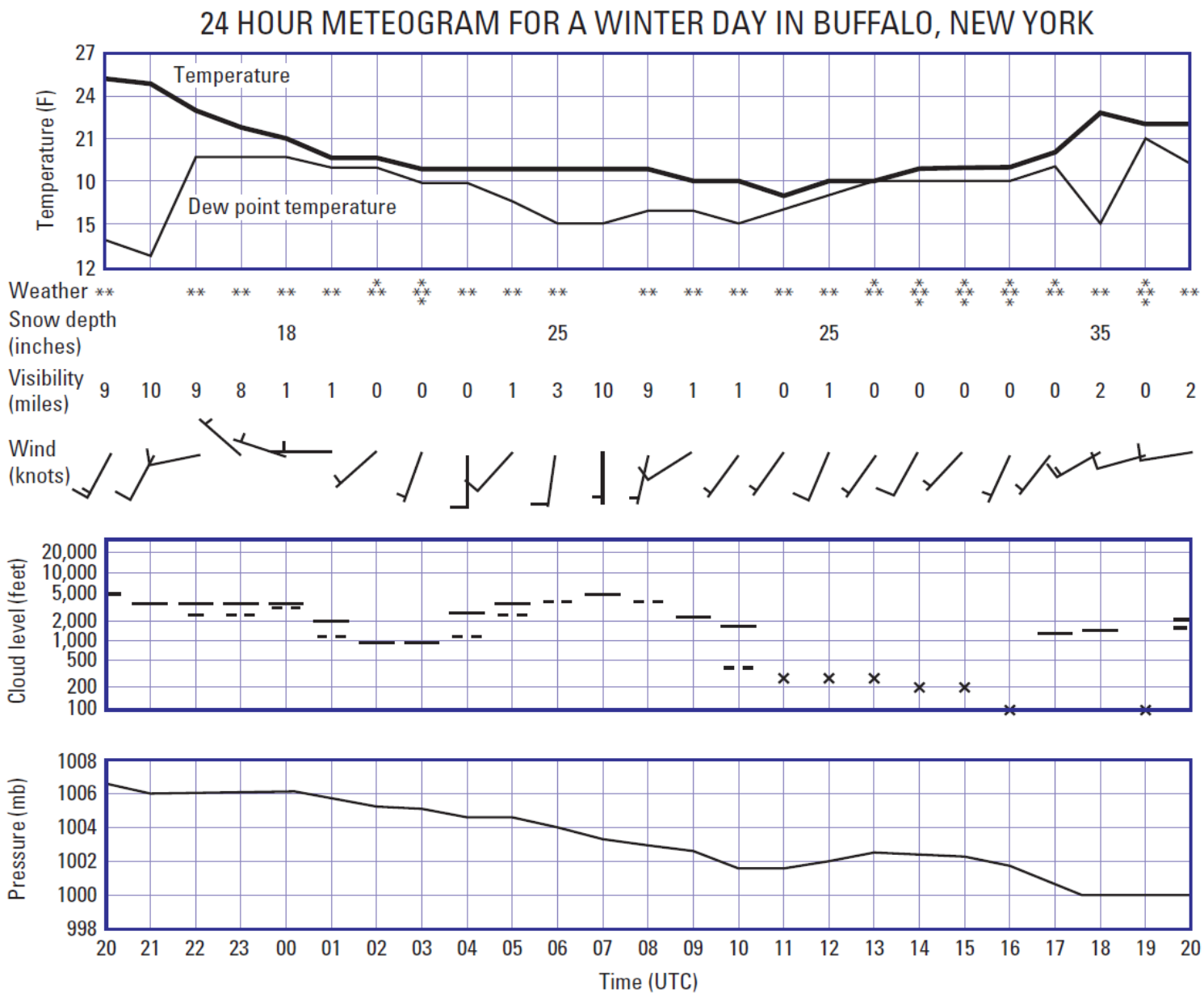
ASOS Instruments

- Visibility Sensor

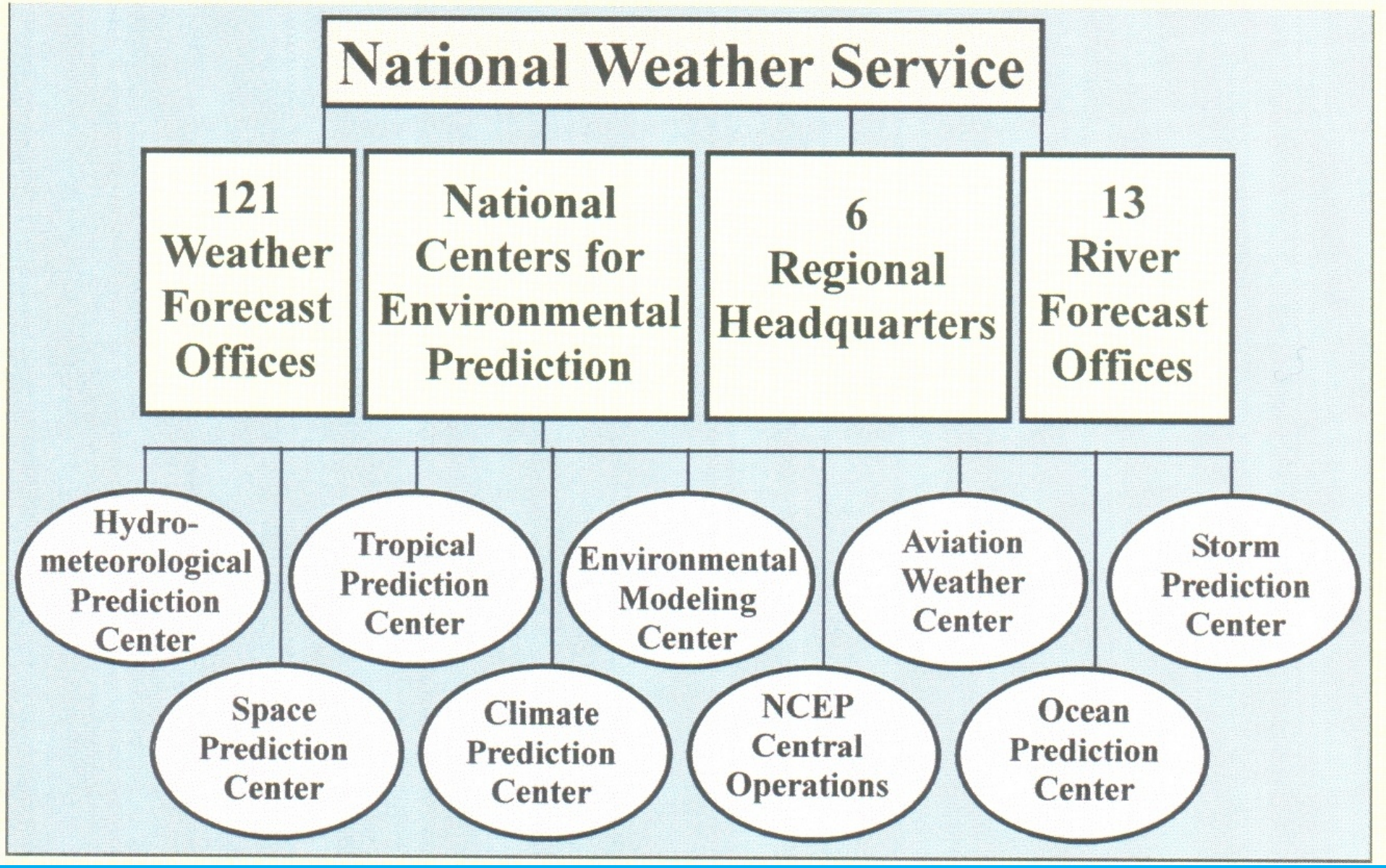
- Present Weather

North American Surface Observing Sites

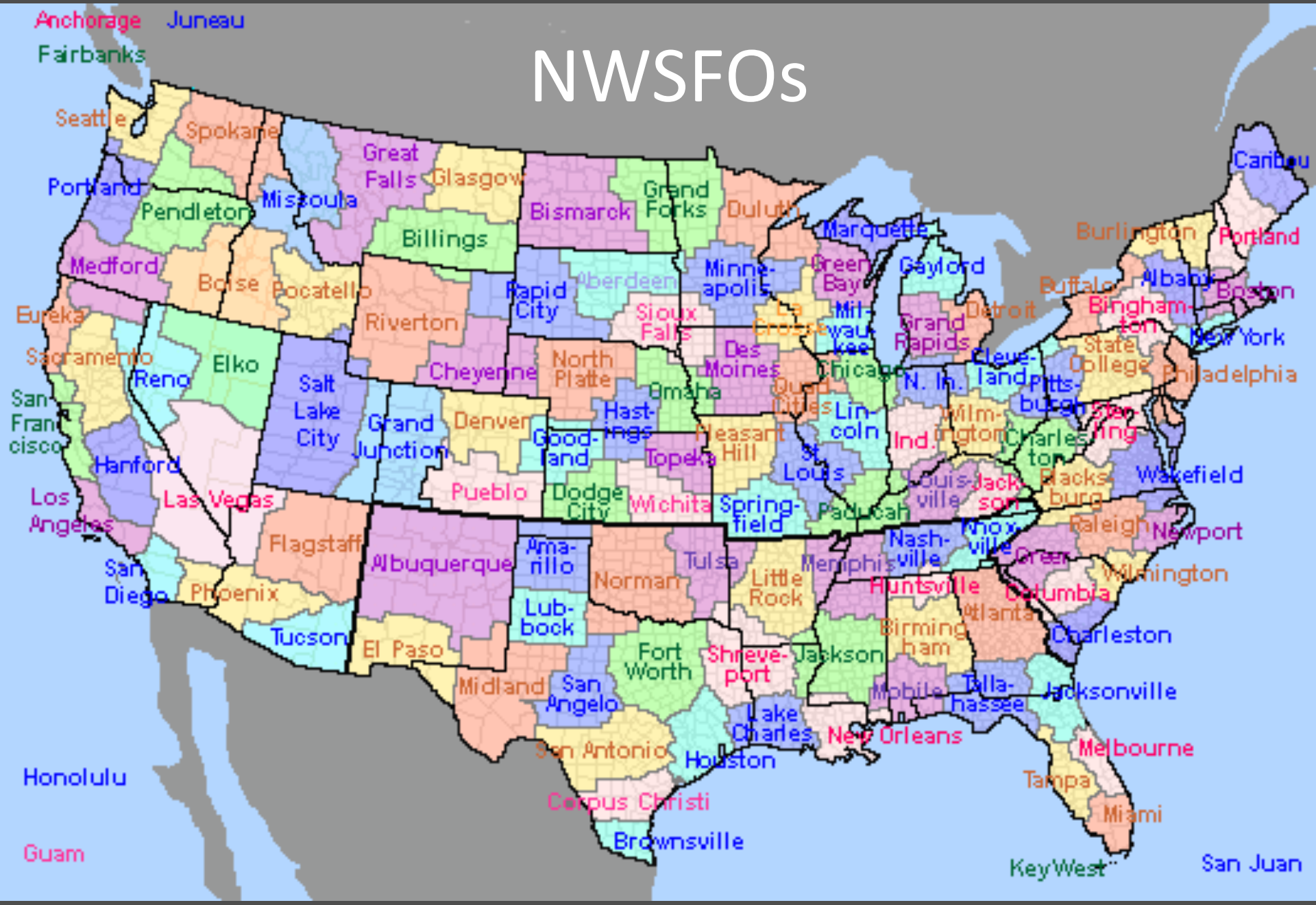
Meteogram



Time (UTC)


National Weather Service
121 Weather Forecast Offices
National Centers for Environmental Prediction
6 Regional Headquarters
13 River Forecast Offices
Hydro-meteorological Prediction Center
Tropical Prediction Center
Environmental Modeling Center
Aviation Weather Center
Storm Prediction Center
Space Prediction Center
Climate Prediction Center
NCEP Central Operations
Ocean Prediction Center

NWSFOs


Anchorage
Juneau
Fairbanks
Seattle
Spokane
Great Falls
Glasgow
Bismarck
Grand Forks
Duluth
Portland
Pendleton
Missoula
Billings
Medford
Boise
Pocatello
Rapid City
Aberdeen
Minne-apolis
Eureka
Riverton
Sioux Falls
Sacramento
Reno
Elko
Cheyenne
North Platte
Des Moines
Salt Lake City
Grand Junction
Denver
Omaha
Hast-ings
San Fran-cisco
Good-land
Topeka
Pleasant Hill
Hanford
Pueblo
Dodge City
Wichita
Spring-field
St Louis
Los Angeles
Las Vegas
Flagstaff
Albuquerque
Ama-rillo
Norman
Tulsa
San Diego
Phoenix
Lub-bock
Little Rock
Memphis
Tucson
El Paso
Fort Worth
Shreve-port
Jackson
Midland
San Angelo
Lake Charles
New Orleans
San Antonio
Houston
Corpus Christi
Brownsville
Honolulu
Guam
Marquette
Gaylord
Green Bay
Mil-wau-kee
Chicago
Grand Rapids
Detroit
Lin-coln
Ind.
Louis-ville
Nash-ville
Paducah
Knox-ville
Huntsville
Birming-ham
Atlanta
Mobile
Talla-hassee
Caribou
Burlington
Portland
Buffalo
Albany
Boston
Bingham-ton
New York
State College
Philadelphia
Cleve-land
Pitts-burgh
N. In.
Wilm-ington
Charles-ton
Black-sburg
Wakefield
Raleigh
Newport
Green
Wilmington
Columbia
Charleston
Jacksonville
Melbourne
Tampa
Miami
KeyWest
San Juan

Upper-level measurements: Rawinsondes

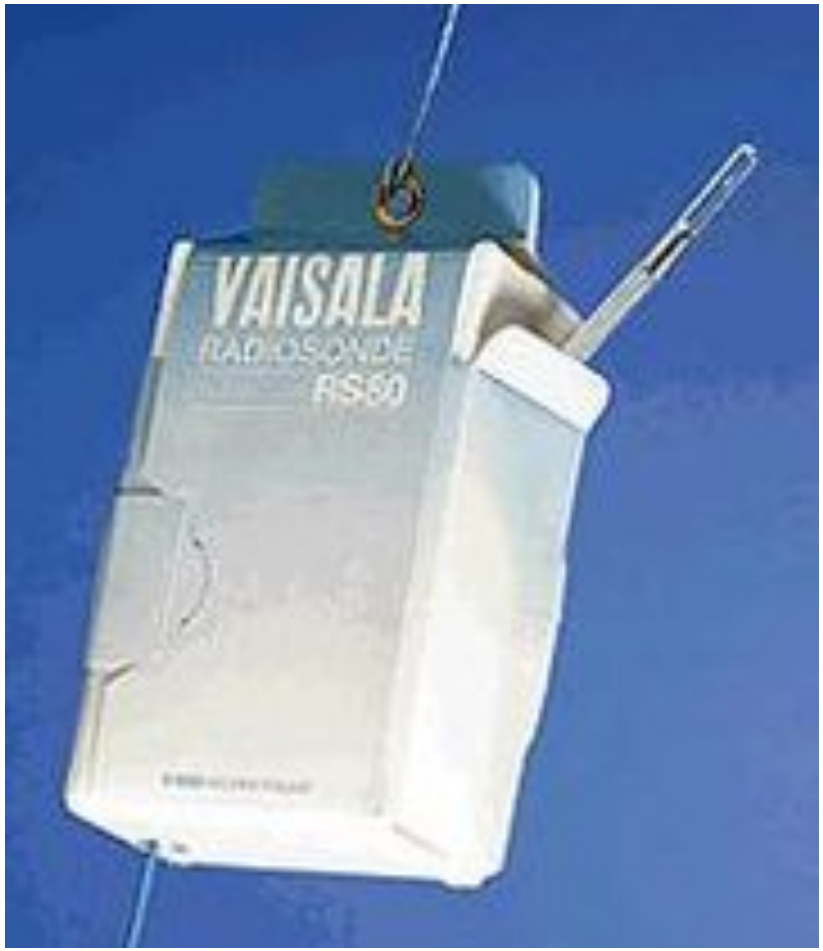
- To measure the vertical profile of T, Td, P, and wind
- Balloon-borne, launched worldwide twice a day
- A sounding is a depiction of the vertical structure of the atmosphere above a location on the Earth, as measured by a rawinsounde or dropsonde.
- Costly, stations are 500-km apart

NWS Rawinsonde Launch and WSR-88D Radar Site

Balloon Shack

Filling and Launching

Instrument Package

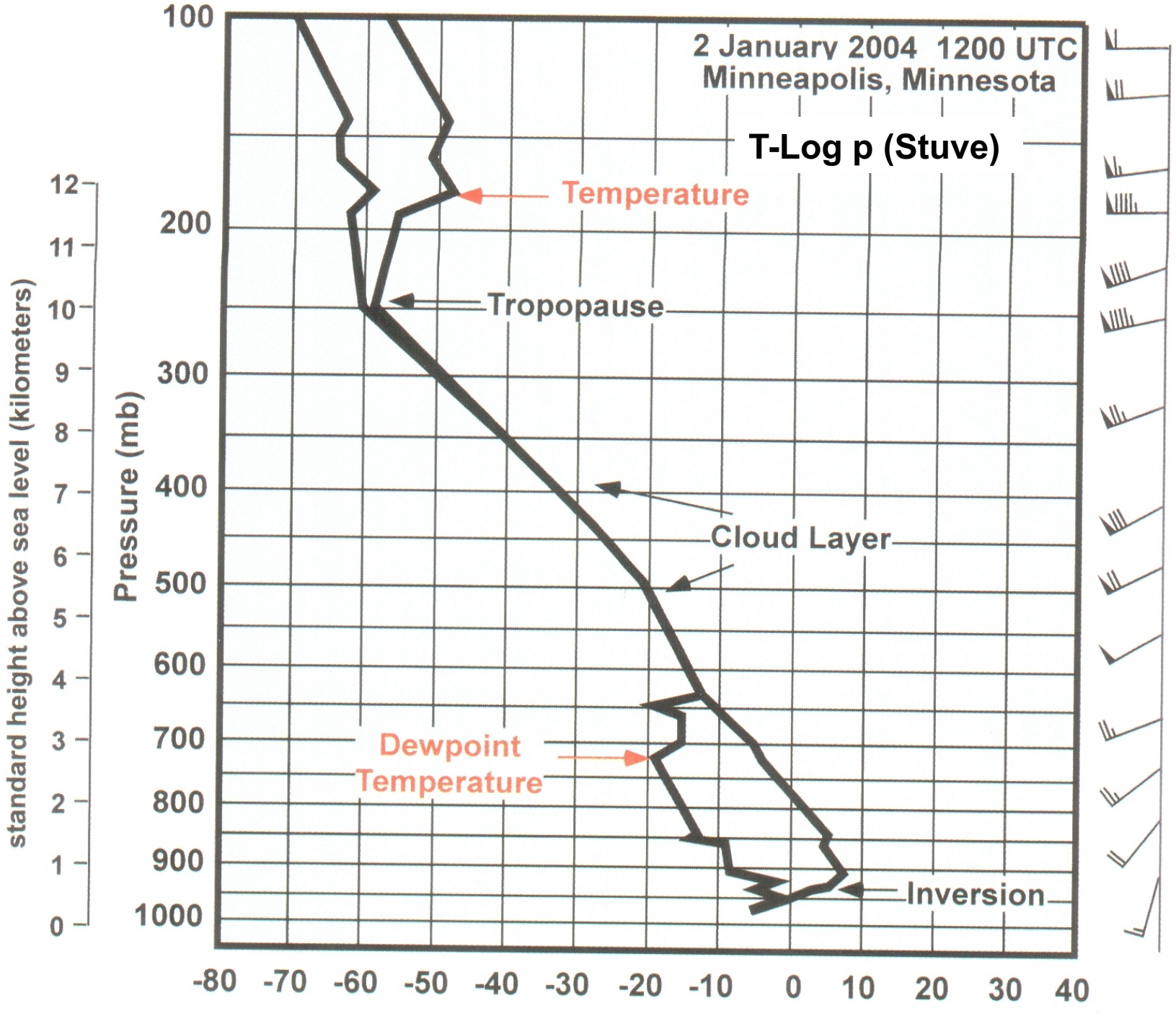


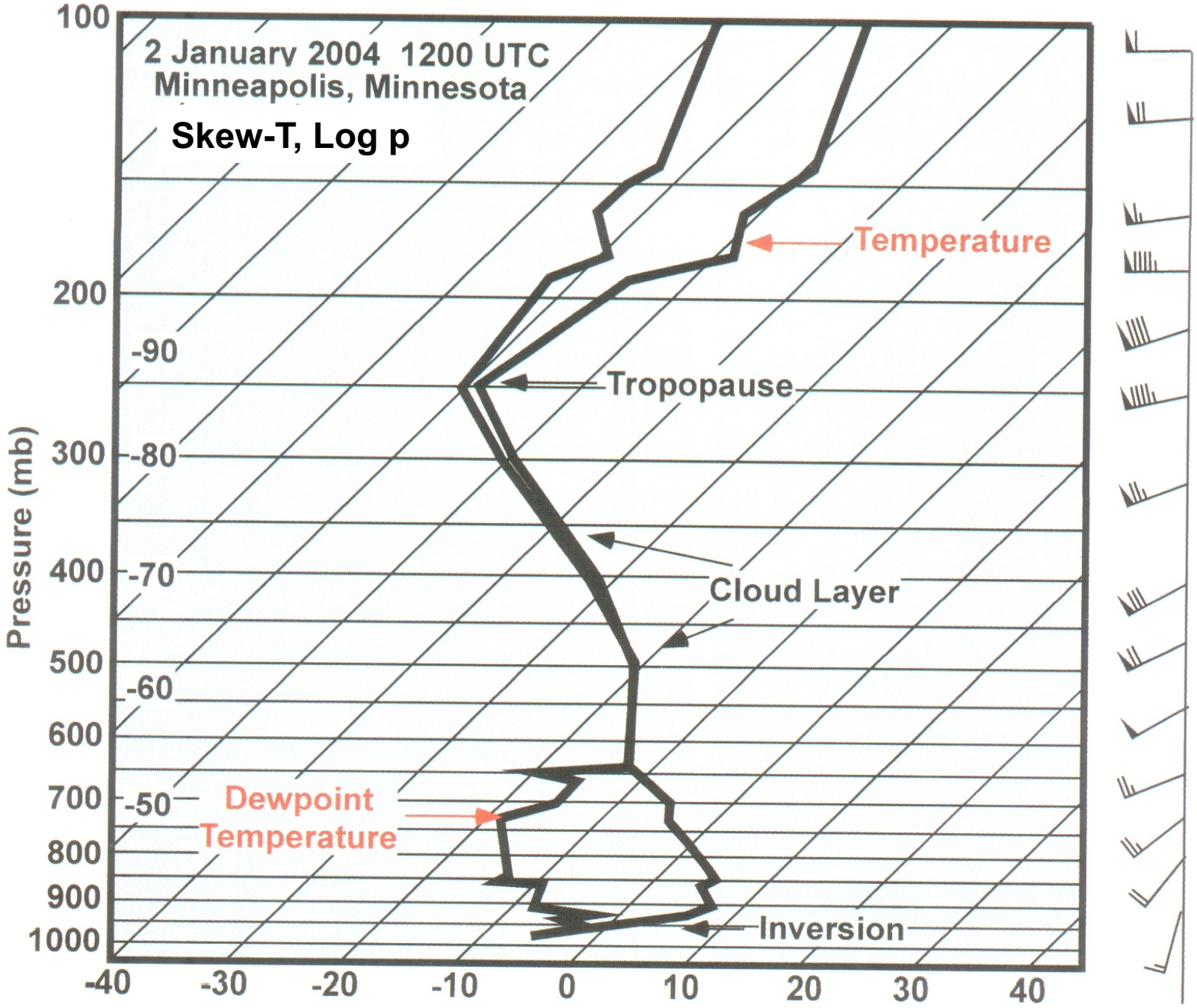
- Cardboard box
- Weighs 250-300 gm
- Thermistor
- Capacitive moisture sensor
- Aneroid pressure sensor
- Tracked by GPS
- Line-of-sight tracking

Airborne

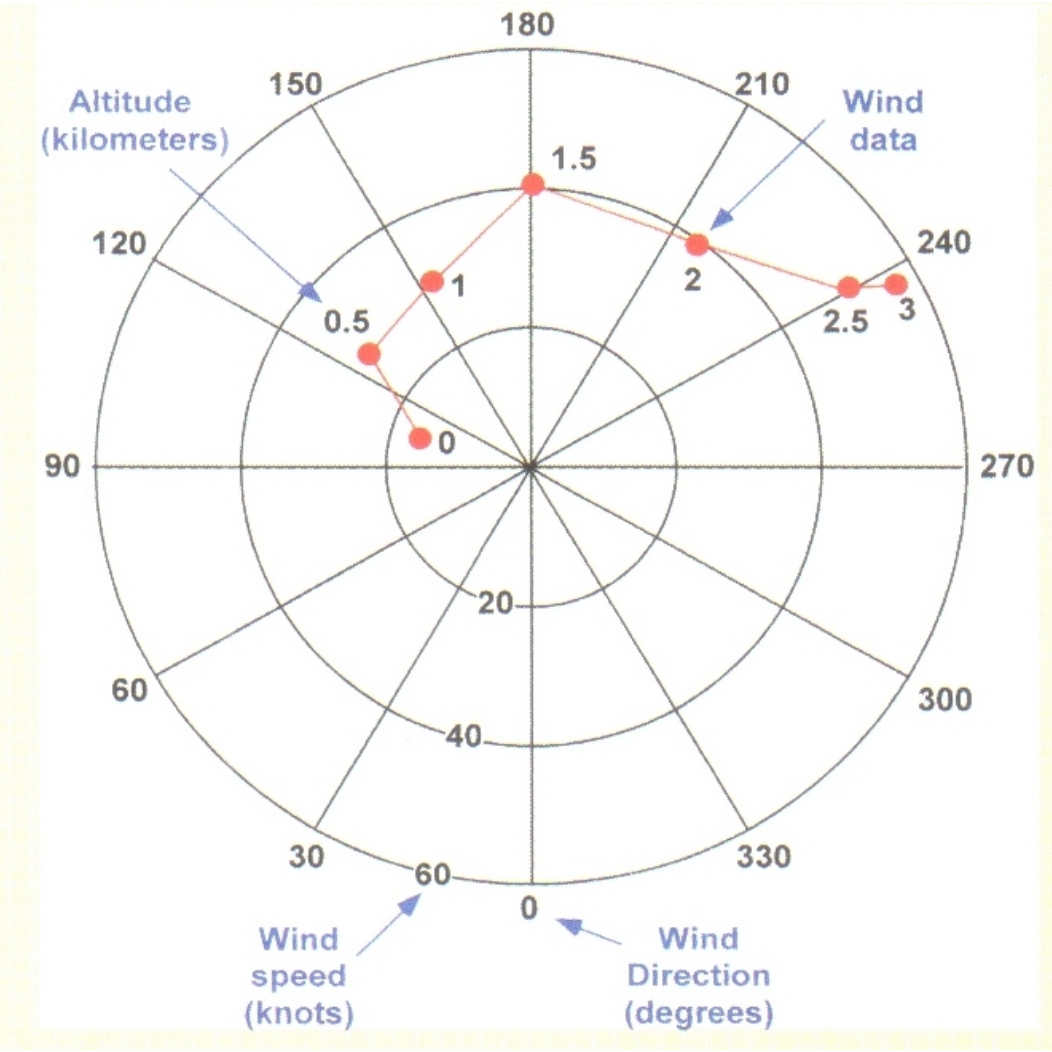
- Airborne for 60-90 min
- Launch 50-min before synoptic time
- Normally at 00Z and 12Z
- Balloon bursts at ~20 km
- Intensive launches
  - Severe weather outbreaks
  - Research campaigns

North American Rawinsonde Sites


2 January 2004 1200 UTC
Minneapolis, Minnesota
T-Log p (Stuve)
Temperature
Tropopause
Cloud Layer
Dewpoint
Temperature
Inversion
Pressure (mb)
100
200
300
400
500
600
700
800
900
1000
standard height above sea level (kilometers)
0
1
2
3
4
5
6
7
8
9
10
11
12
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40

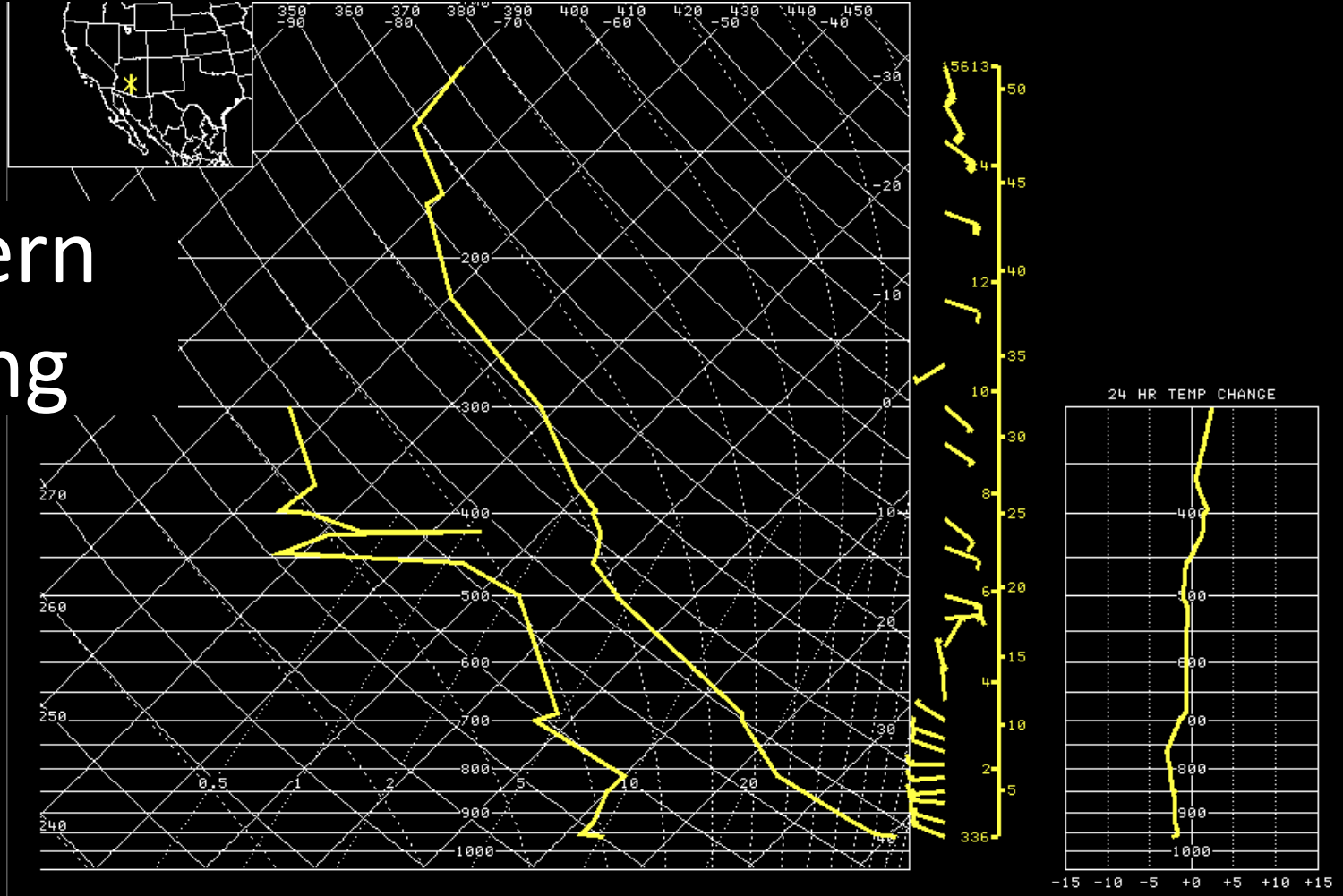

2 January 2004 1200 UTC
Minneapolis, Minnesota
Skew-T, Log p
Temperature
Tropopause
Cloud Layer
Dewpoint
Temperature
Inversion
Pressure (mb)
100
200
300
400
500
600
700
800
900
1000
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40

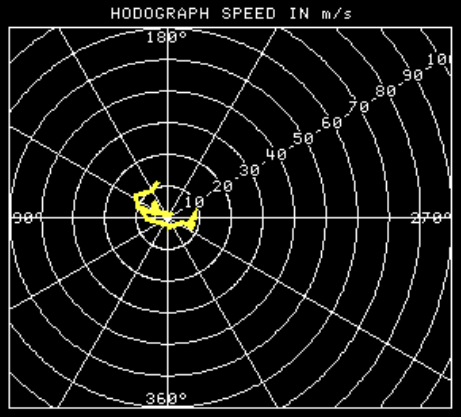
Hodograph: Shows wind as a function of height (wind shear)



- Distance from center denotes wind speed
- 0 degree north at bottom
- 90 degree East on the left
- wind direction is “from” the indicated degree
- The length of red line between two points denotes wind speed shear
- The angle between the line denotes directional wind shear
- Severe weather: winds increase rapidly above the sfc; and change direction from SE near sfc to SW aloft

A Modern Sounding





PRECIP WATER= 1.17 in
K-INDEX= 26
TOTALS INDEX= 52
SWEAT INDEX= 233
DRY MICROBURST POT=2: GST < 30 kts
FREEZING LEVEL= 16639 ft ASL
WET-BULB ZERO HGT= 14260 ft ASL
0-6 KM AVG WIND= 292°/5 kts
0-6 KM STM MTN (30R75)= 322°/4 kts
0-3 KM STM REL HELICITY= -5 m²/s²
FORECAST MAX TEMP=NA
TRIGGER TEMP= 38°C/101°F
SOARING INDEX=NA

-PARCEL- T=SFC;Td=SFC
INIT PARCEL P= 960 105 56 ° mb
INIT PARCEL T/Td= 105/56°F!40/13°C
CONVECTIVE TEMP= 114°F
LIFTED INDEX= -4.4
CCL= 13984 ft ASL/ 611 mb
LCL= 12262 ft ASL/ 652 mb
LFC= 15296 ft ASL/ 582 mb
MAX HAILSIZE= 8.8 cm/3.4 in
MAX VERTICAL VELOCITY= 43 m/s
EQUIL LEVEL= 43717 ft ASL/173 mb
APPROX CLOUD TP=NA
POSITIVE ENERGY ABV LFC= 1276 J/KG
NEGATIVE ENERGY BLW LFC= -142 J/KG
BULK RICHARDSON NUMBER= 103.5

KPSR Skewt Mon 00:00Z 15-Jul-02

Summary

- Surface observations of weather elements and sky conditions---ASOS---every hour.
- Upper-air observations, Rawinsondes at 00Z and 12Z. T,TD,P & Wind into the lower stratosphere
  - Stuve and Skew-T-Log p Diagrams show T & TD as a function of P