Surface and Upper-Air Observations





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Surface Observations

- Collect information for synoptic-scale weather
- Most surface observations are automated (e.g., Automated Surface Observing System)
  - Also mesoscale networks (mesonet) such as Oklahoma and West TX
- Measurements taken at least hourly
- As early as the 1700s, human observations were taken in the U.S.

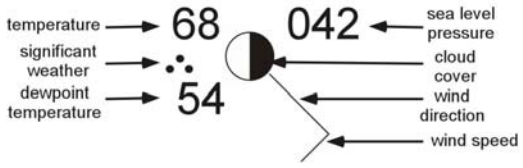
What's Measured at the Surface?

- Temperature (°F)
- Dewpoint temperature (°F)
- Pressure (corrected and reported as MSLP in mb)
- Wind speed and direction (knots or m.p.h.)
- Cloud cover at multiple levels
- Precipitation (amount and time of start/stop)
- Other current weather (distant thunder, towering cumulus, etc.)

Surface Station Plots

- Information plotted on a map in compact format
- Temperature, dewpoint, pressure, cloud cover, wind speed and direction, visibility, current weather and pressure tendency

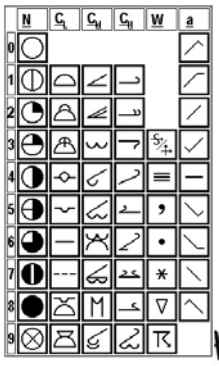
Decoding the Station Plot



- Temperature and dewpoint are in °F
- Wind speed is usually in knots (OK Mesonet uses m.p.h.)
- Pressure is reported in *tenths* of mb
  - If first number >6, put a 9 in front of number reported
  - If first number <4, put a 10 in front of number reported

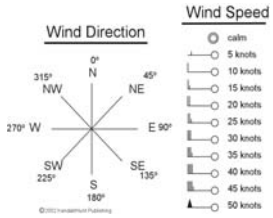
Cloud Cover

No/very few clouds →
1/8 coverage →
2/8 coverage →
3/8 coverage →
4/8 coverage →
5/8 coverage →
6/8 coverage →
7/8 coverage →
Overcast →
Sky obscured →

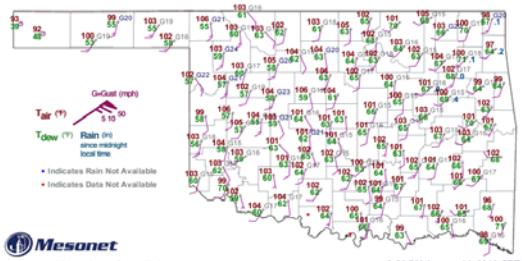


How to Read Wind Speed and Direction

- Meteorologists always describe where the wind is coming *from*!!
- Describe wind speed in knots
- Direction by cardinal direction (N,S,E,W) or using degrees of a circle
- Both surface and upper-level maps



Surface Observation Example: Oklahoma Mesonet



Surface Observation Example

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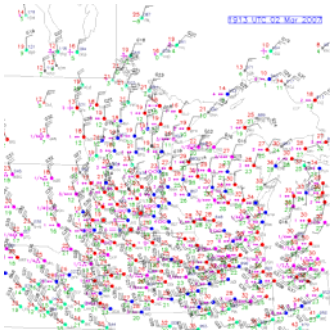
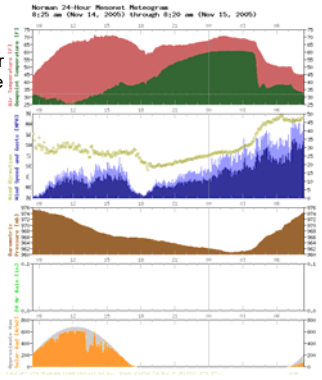


Meteorogram

- Displays surface data over a period of time at a single station



Yes, it's "meteorogram"…

Weather Buoy

- Weather Buoys
  - Collect surface data over the oceans
  - Important for estimating surface moisture return → Great Plains severe weather
  - Tropical storm winds from buoys

Upper-Air Observations

- Rawinsondes or radiosondes collect data
  - Used since the 1950s
  - Sent by balloon
- Can plot vertical profile from one balloon
  - Called a sounding
- Can plot horizontal view of upper atmosphere with many radiosondes, using pressure as the vertical coordinate

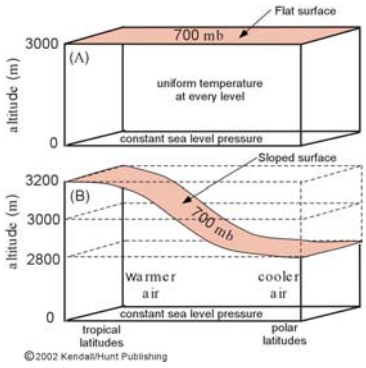
Data Collected by Weather Balloons

- Temperature (°C)
- Mixing ratio (g/kg)
- Wind speed and direction (kts)
- Pressure (mb or hPa)
- Height above ground (meters)

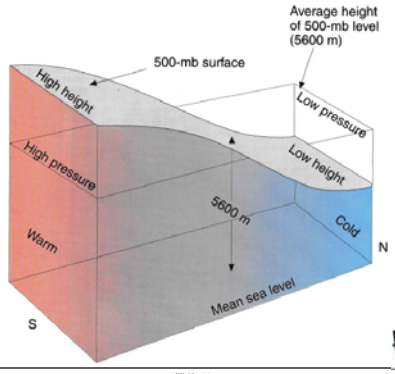
Upper-Air Maps

- In meteorology, pressure is vertical coordinate
  - Pressure always decreases with height
  - Constant pressure maps
  - Not truly horizontal (quasi-horizontal)
  - Temperature variations lead to differing heights of constant pressure surfaces
- Height of troposphere changes depending on latitude; higher in tropics, lower at poles

Sloped Pressure Surfaces



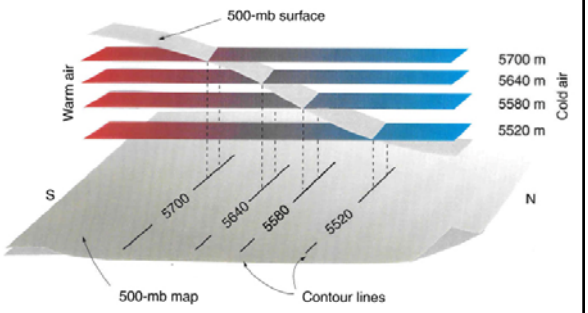
Sloped Pressure Surfaces



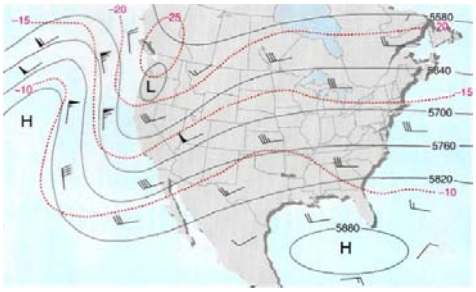
Contours

- In order to help visualize data, meteorologists draw lines or contours to help “see” the data
- Typically contour:
  - Temperature (isotherms)
  - Pressure (isobars)
  - Height of a constant pressure surface (isoheights)
  - Dewpoint (isodrosotherms)
  - Wind speed (isotachs)

Formation of a Constant Pressure Chart

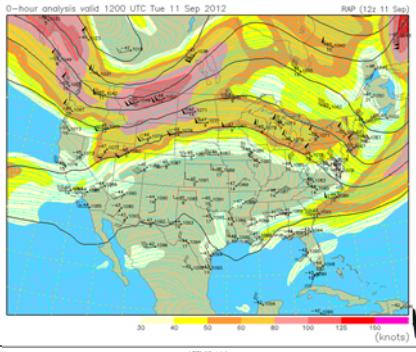


A Simplified 500-mb Chart



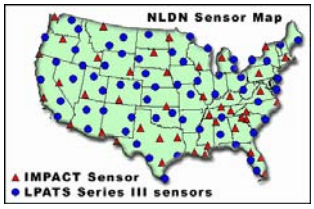
A Real 250-mb Upper-Air Map

250 mb Heights (dm) / Isotachs (knots)



National Lightning Detection Network

- Senses cloud-to-ground lightning across U.S.
- Developed in late 1980s as a 2-D NLDN
- National Severe Storms Laboratory recently developed a 3-D Lightning Mapping Array (LMA) for cloud-ground and cloud-cloud lightning (very cool!)



Ways to measure rain: National Weather Service Standard Gauge

Ways to measure rain: CoCoRaHS Gauge

Community Collaborative Rain, Hail & Snow Network

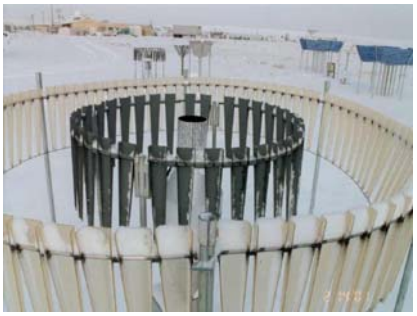
Ways to measure rain: Weighing Gauge (Fischer-Porter)

Ways to measure rain: Weighing Gauge (Fischer-Porter internal view)

Ways to measure rain: Vibrating wire rain gauge (Geonor)

Ways to *correctly* measure rain: Alter shield

An alter shield reduces undercatch due to wind



Ways to measure rain: Tipping bucket gauge with alter shield

Ways to measure rain: Tipping bucket gauge mechanism