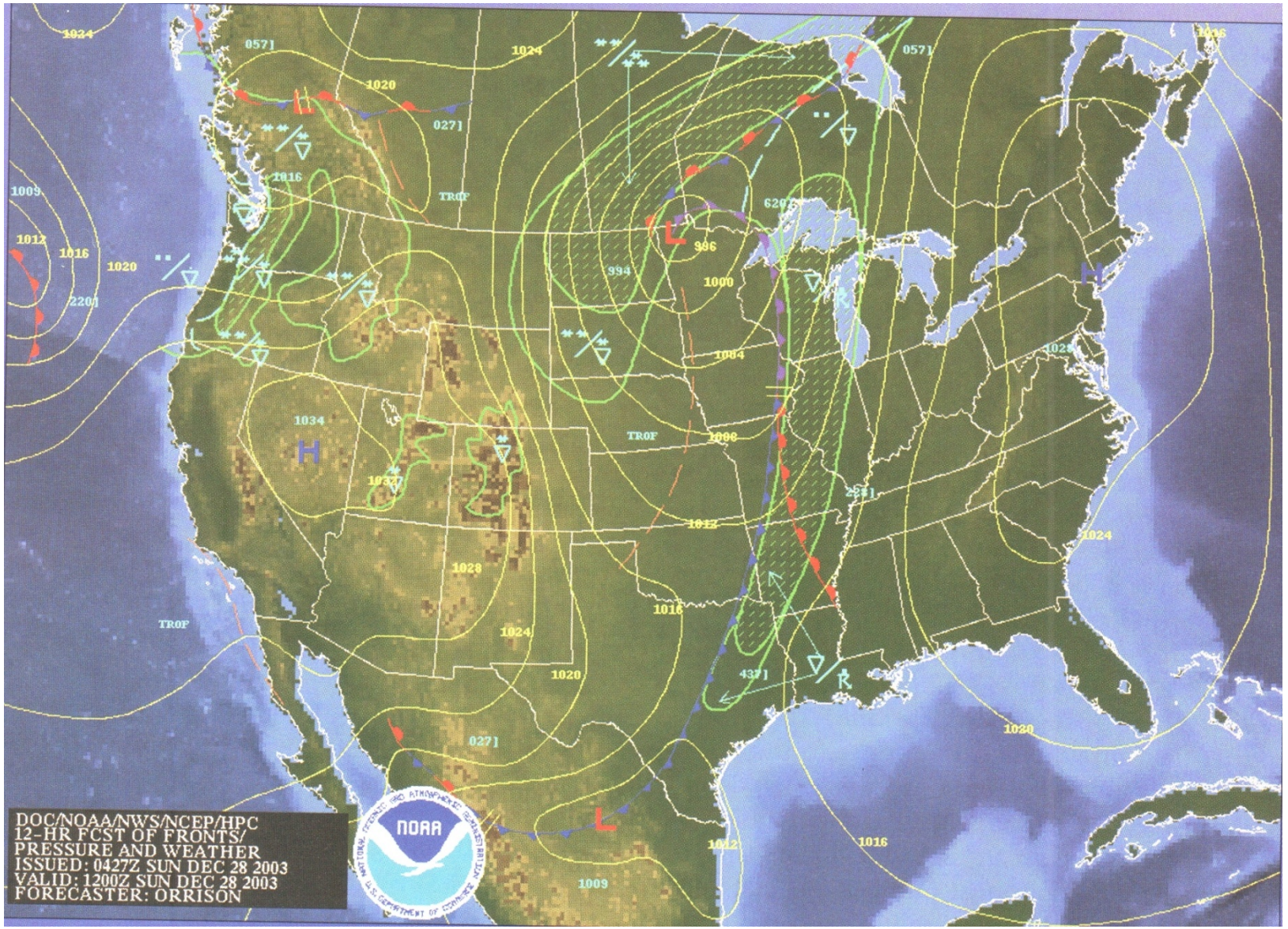
# MET 4300/5355

## Lecture 5

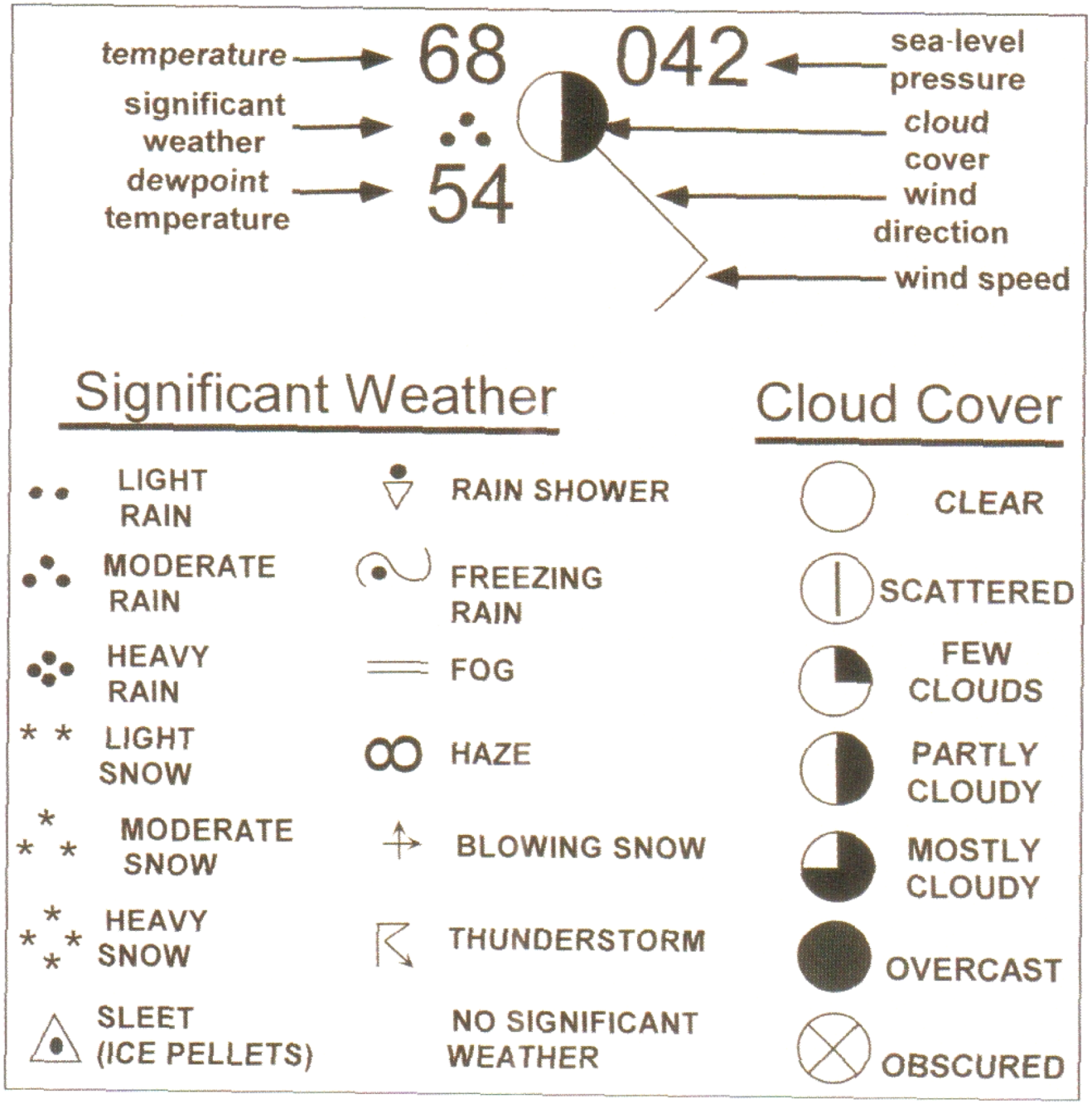
## Weather Maps (CH3)

# Surface Weather Map

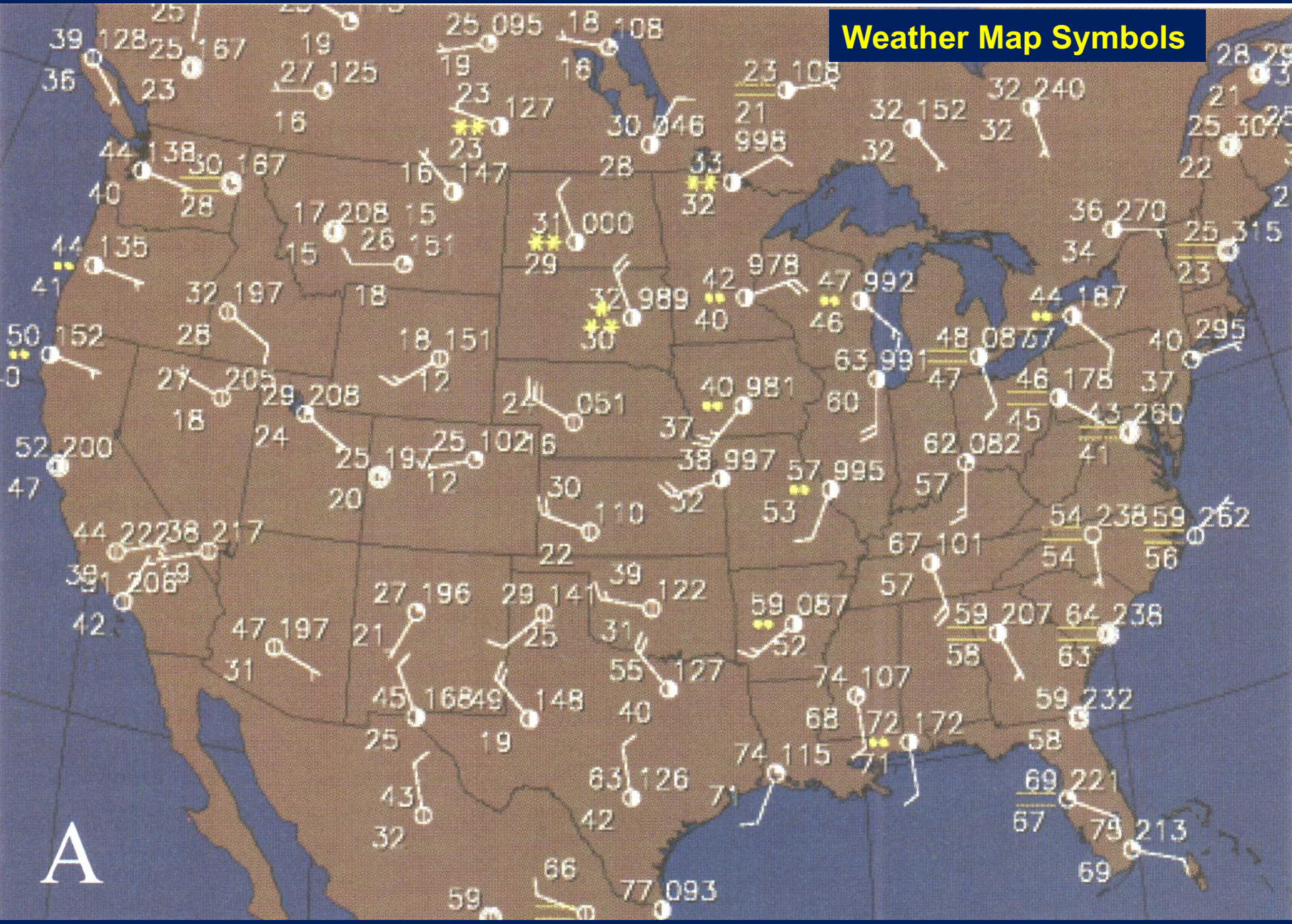


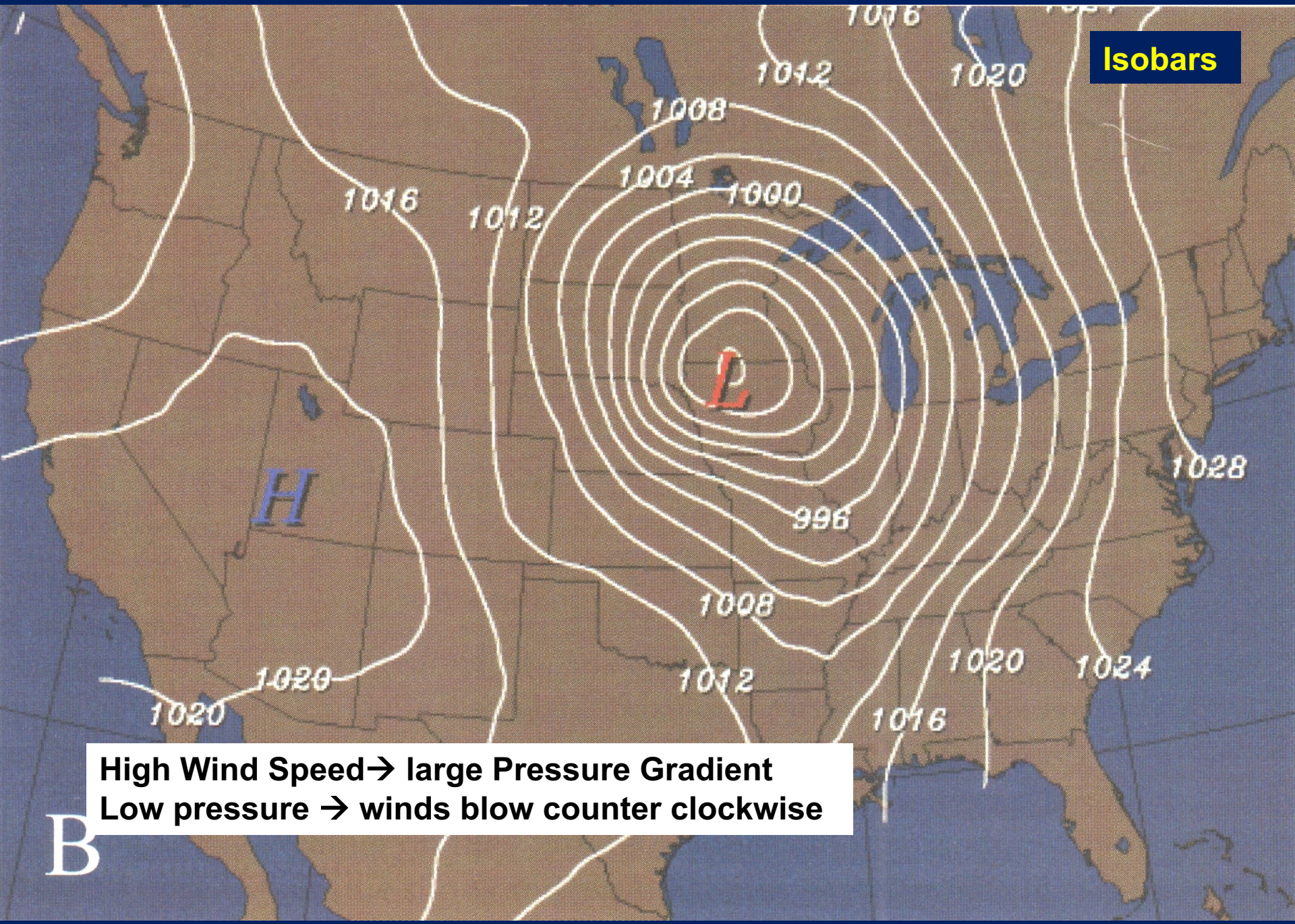
# Surface weather maps and surface station model

- Parameters on **surface weather maps**: sea-level pressure, surface T, Td, wind, and precipitation
- Useful for knowing what weather is happening
- Will need the structure of upper atmosphere to understand WHY.
- **Surface station model**: hourly ASOS weather data (T, Td, P, Precip., wind) are plotted on station model


temperature
68
042
sea-level pressure
significant weather
cloud cover
dewpoint temperature
54
wind direction
wind speed
Significant Weather
LIGHT RAIN
MODERATE RAIN
HEAVY RAIN
LIGHT SNOW
MODERATE SNOW
HEAVY SNOW
SLEET (ICE PELLETS)
RAIN SHOWER
FREEZING RAIN
FOG
HAZE
BLOWING SNOW
THUNDERSTORM
NO SIGNIFICANT WEATHER
Cloud Cover
CLEAR
SCATTERED
FEW CLOUDS
PARTLY CLOUDY
MOSTLY CLOUDY
OVERCAST
OBSCURED

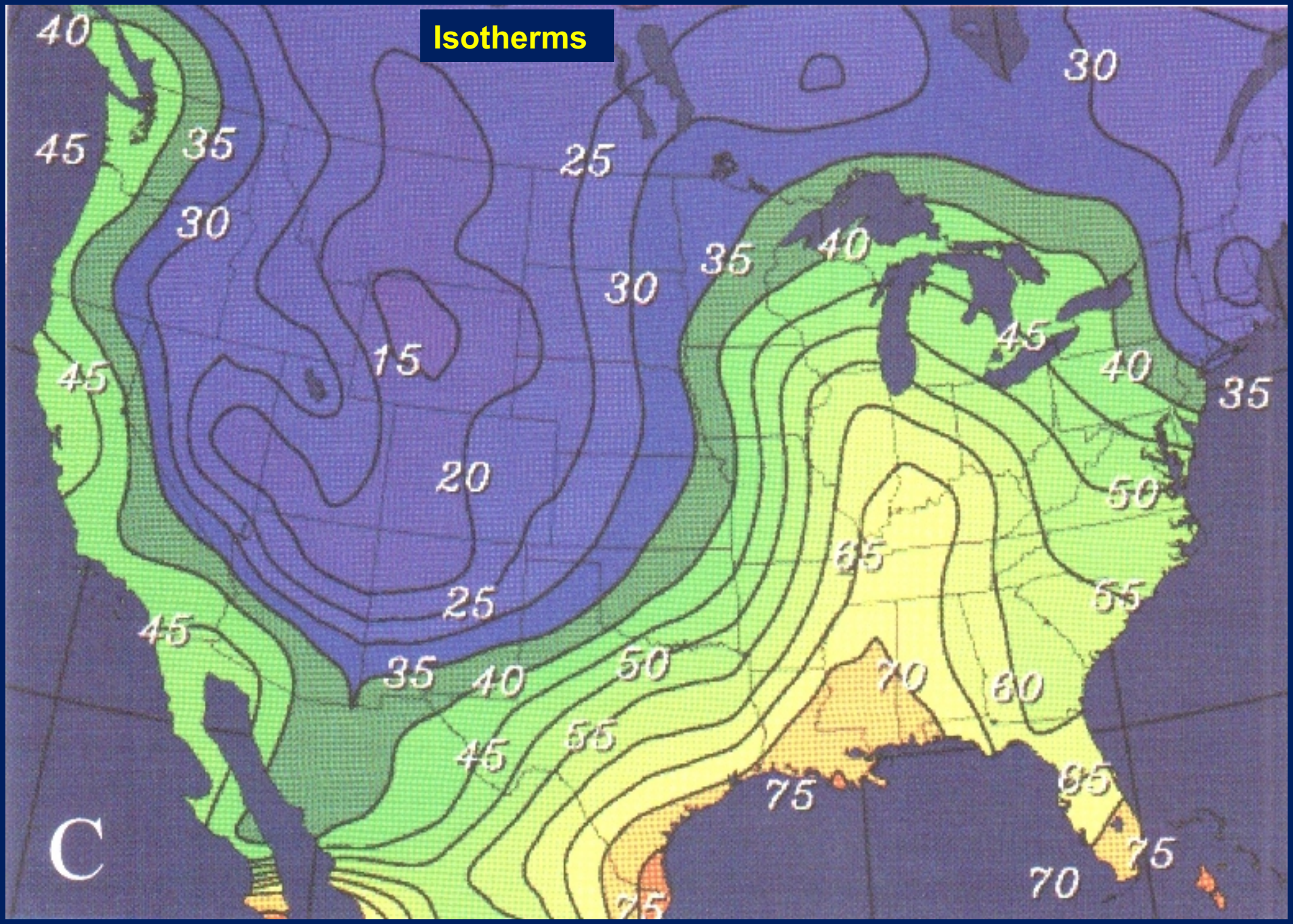
# Weather Map Symbols

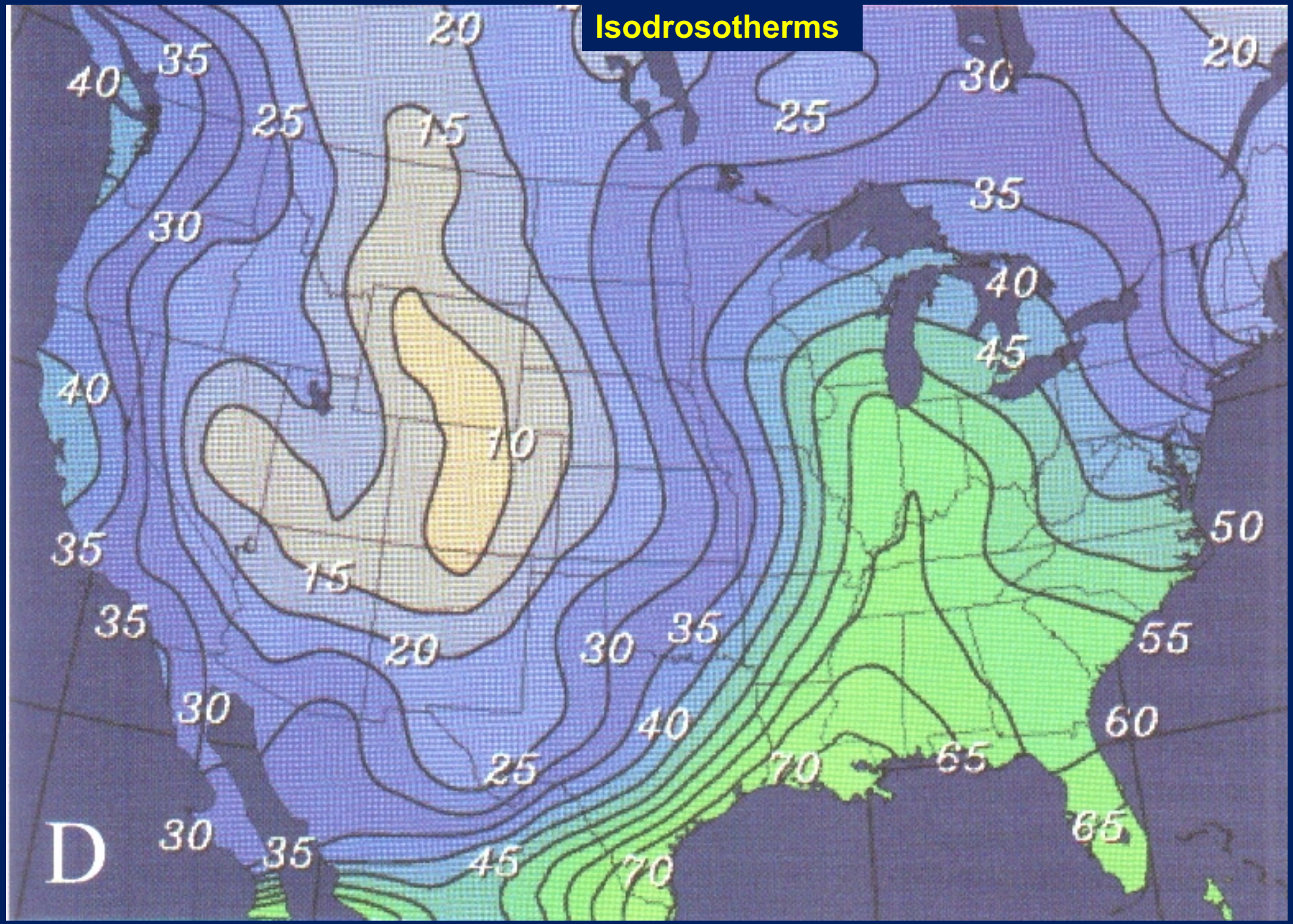





**High Wind Speed→ large Pressure Gradient**
**Low pressure → winds blow counter clockwise**

B

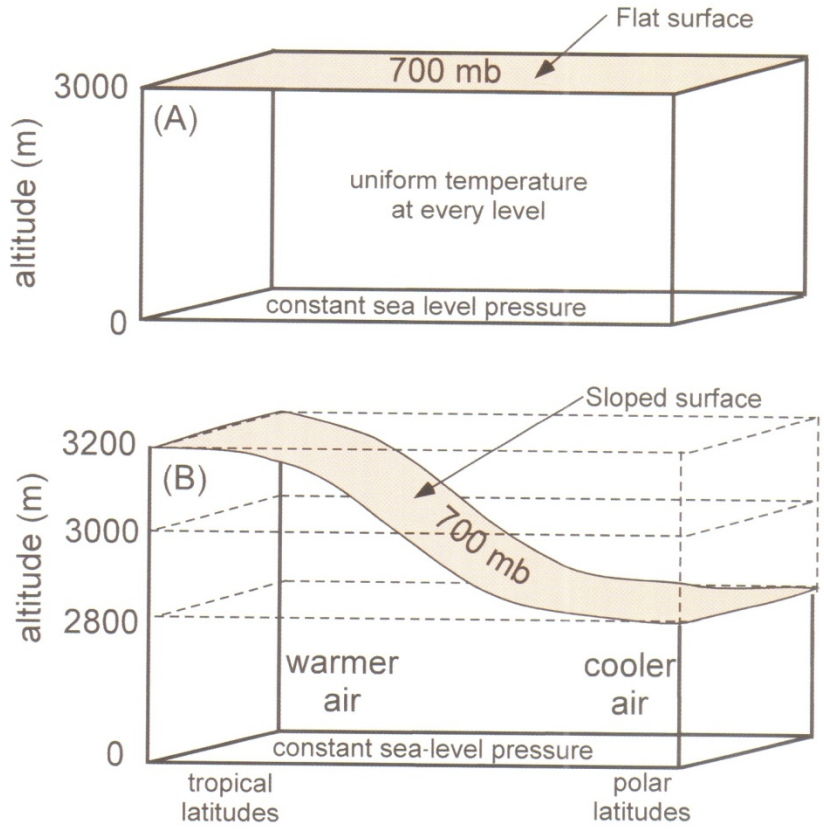

Isotherms
40
45
35
30
25
30
35
40
30
45
15
45
40
35
20
50
65
55
25
45
35
40
50
70
60
55
45
75
65
75
70
C


Isodrosotherms
20
35
40
25
15
30
25
30
20
35
40
45
40
10
50
35
15
35
20
30
35
55
30
40
60
25
70
65
D
30
35
45
70
65

# Pressure as a Vertical Coordinate

- **Aviation reason**: Altimeters on most aircarft actually measure pressure, and use pressure to estimate altitude.
- **Rawinsonde**: measure pressure instead of altitde
- **Fluid dynamic theories**: equations are often in pressure coordinate

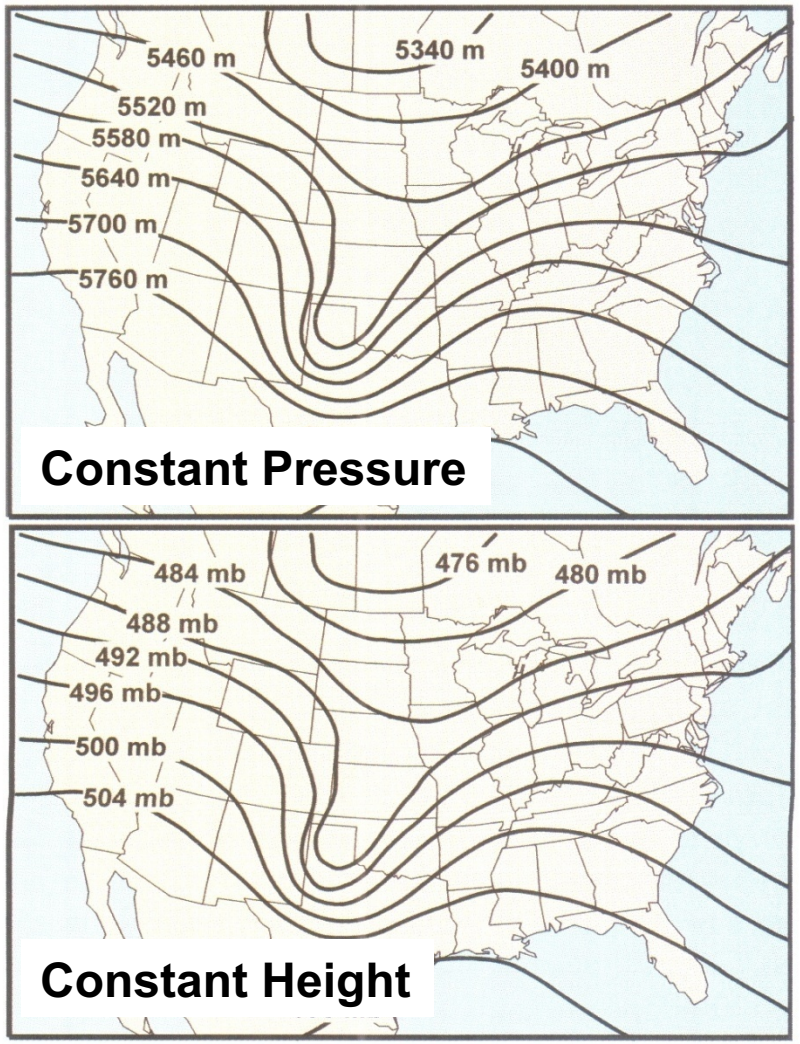
# What does a constant pressure surface look like?




- All the pressure surfaces in the troposphere slope downward from the tropics (warm) to the polar regions (cold).

# Comparing constant height and constant pressure maps

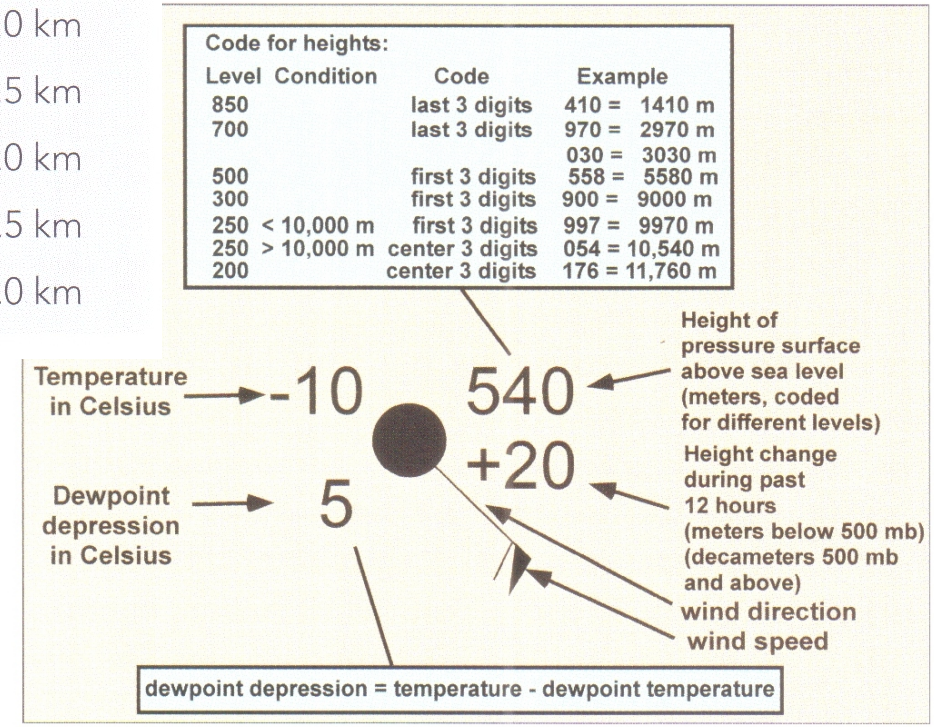
- The height contours of a pressure surface convey the same information as the pressure contours of a constant altitude surface
- Strong pressure gradient → strong height gradient
- High pressure → high height (ridge)
- Low pressure → low height (trough)



# Upper-Air Charts and Symbols

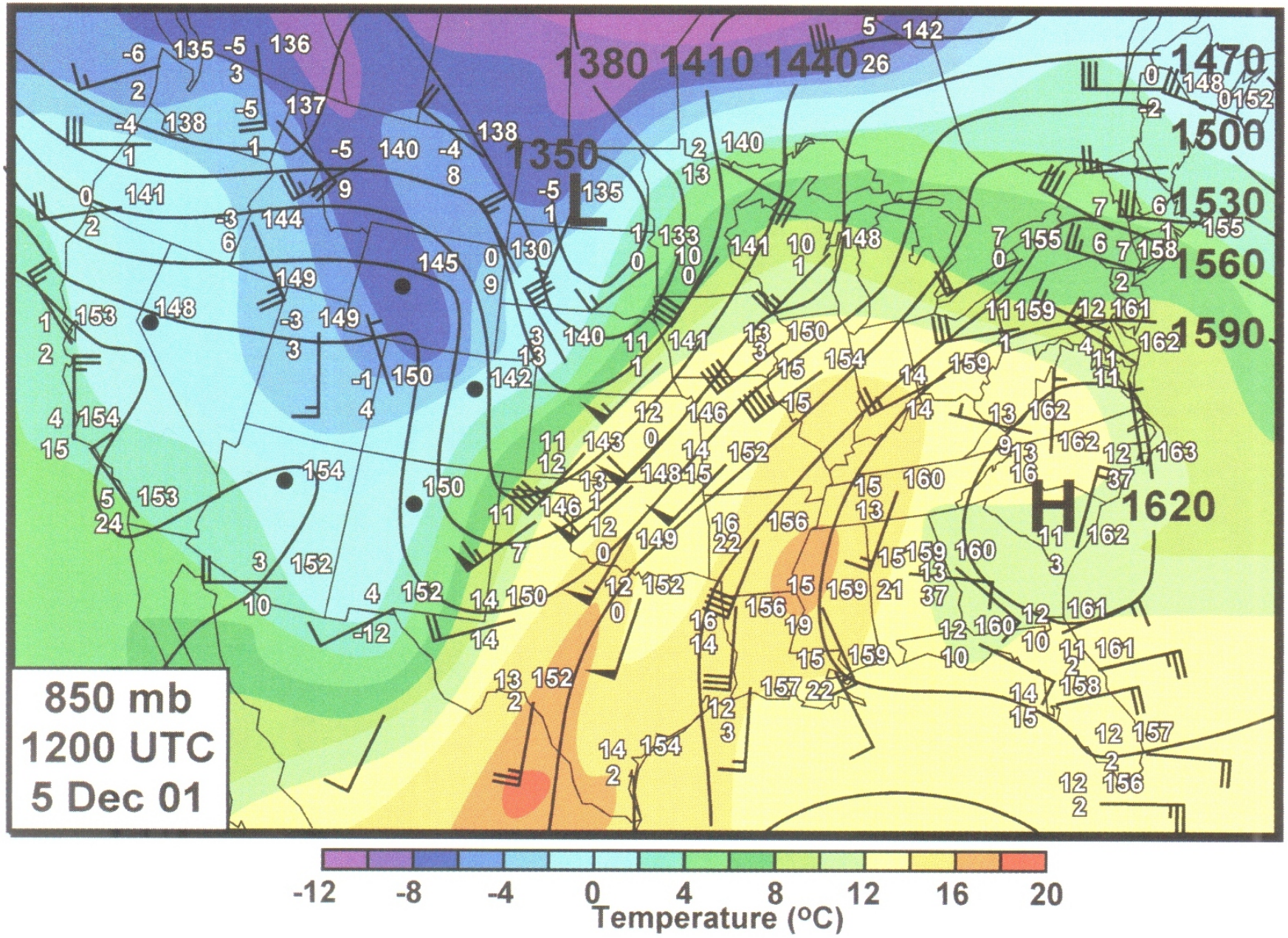
**Table 3.1** Commonly Available Constant Pressure Maps

| Pressure Level | Approximate Altitude (feet) | Approximate Altitude (km) |
|---|---|---|
| 850 mb | 5000 ft | 1.5 km |
| 700 mb | 10,000 ft | 3.0 km |
| 500 mb | 18,000 ft | 5.5 km |
| 300 mb | 30,000 ft | 9.0 km |
| 250 mb | 35,000 ft | 10.5 km |
| 200 mb | 39,000 ft | 12.0 km |



# 850 mb (1.5 km) maps

- **Show height contours and temperature contours**
- **Useful to identify the location of fronts, warm/cold advections**
- **Identify low-level jet, a band of strong wind that flows parallel to a front on its warm side.**
- **Identify moisture (clouds, precipitation) – sometime 700 mb maps are even better for moisture**


850 mb
1200 UTC
5 Dec 01
1380
1410
1440
1470
1500
1530
1560
1590
1620
1350
L
H
-12
-8
-4
0
4
8
12
16
20
Temperature (°C)

# 500 mb (5.5 km) maps

- Show height contours and vorticity contours
- Useful to identify the location of short waves and long waves associated with the ridges and troughs (wave intensity is measured by vorticity )
- Identify cyclonic and anticyclonic vorticity advection

# Vorticity is the Tendency of the Wind to Rotate

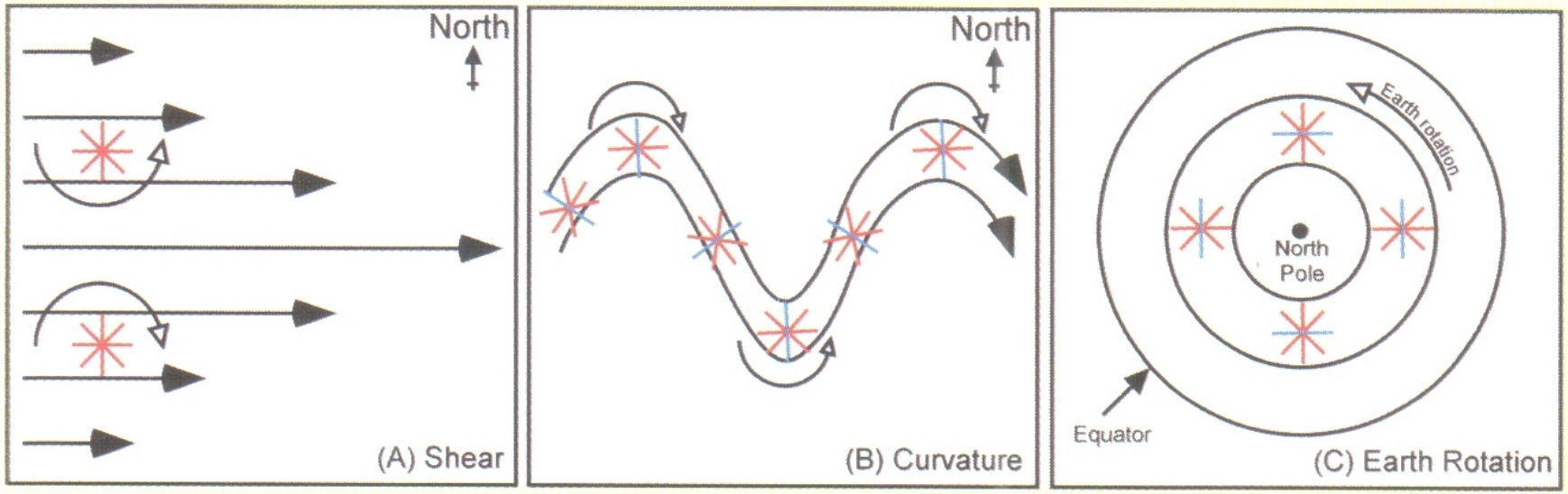
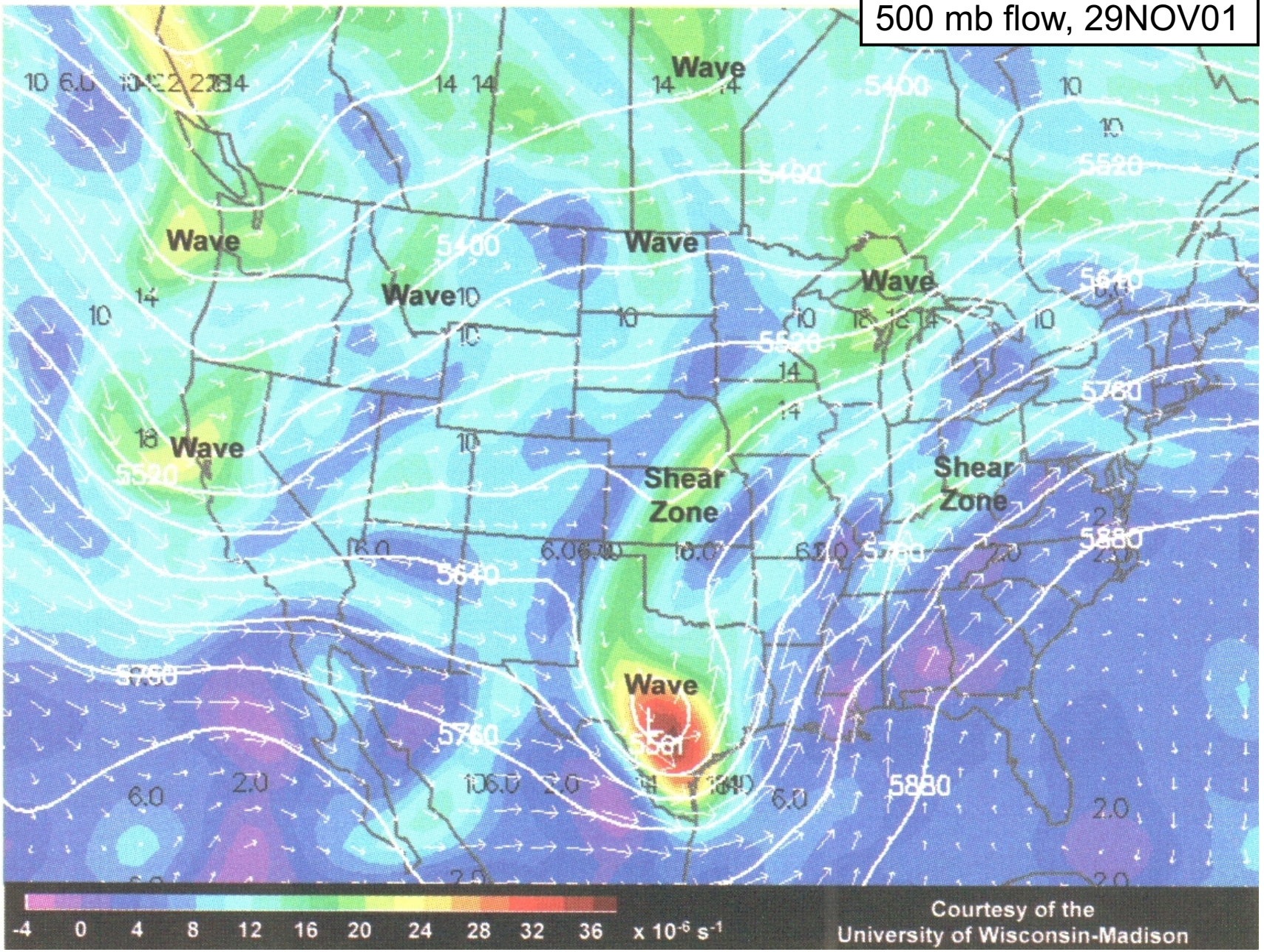


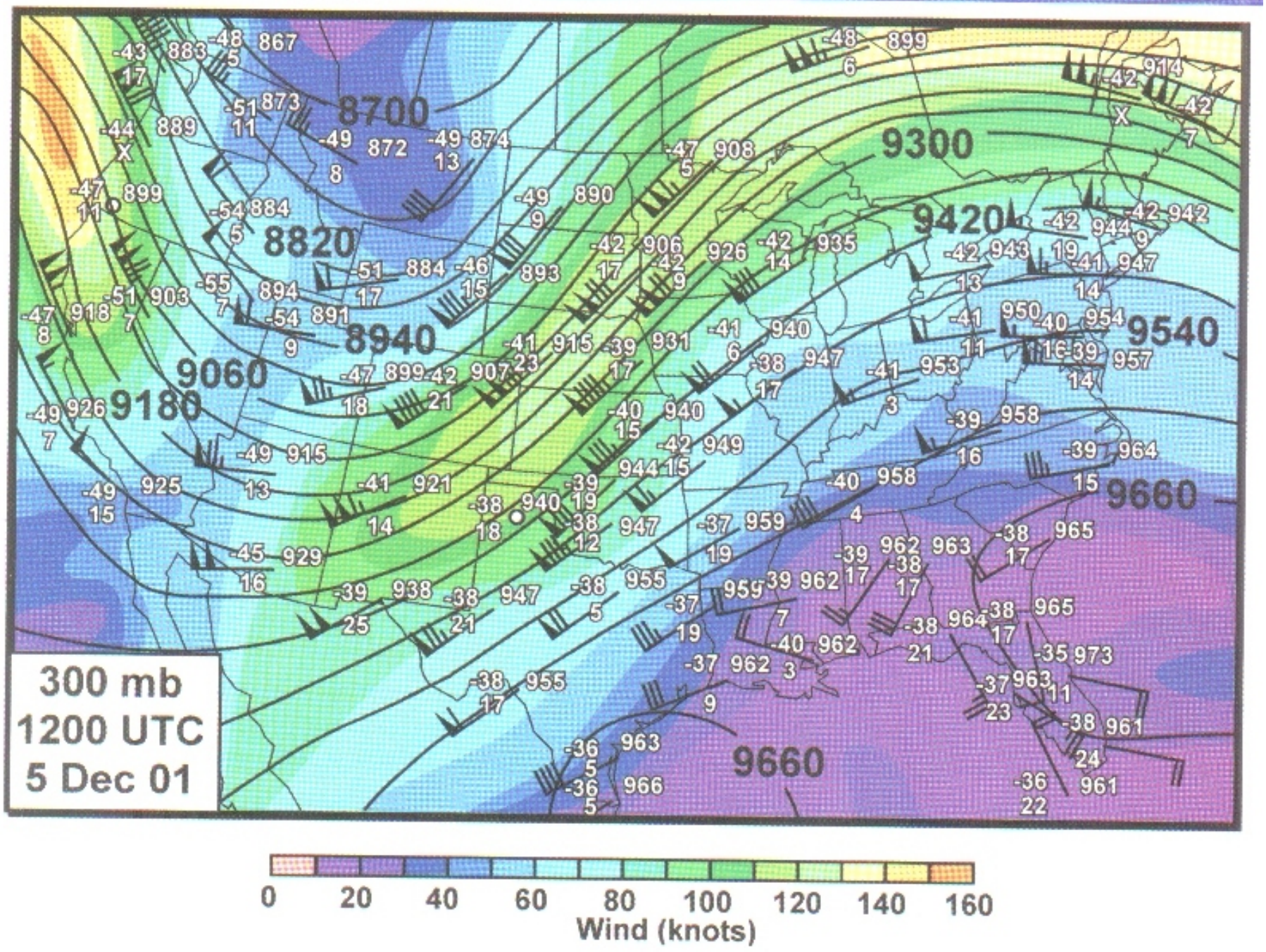

**Figure 3B** Mechanisms that induce local rotation in a flow and create vorticity (A) horizontal wind shear; (B) flow curvature; (C) the rotation of the Earth.

**Use a paddle wheel-like "vorticity meter" so sense cyclonic (counter clockwise in N hemisphere) and Anticyclonic flows.**
**Vorticity tends to stay constant following a moving parcel of air.**


500 mb flow, 29NOV01
Wave
Wave
Wave
Wave
Wave
Wave
Shear Zone
Shear Zone
-4 0 4 8 12 16 20 24 28 32 36 x 10-6 s-1
Courtesy of the University of Wisconsin-Madison

# 300 mb (9 km) maps

- Show height contours and wind speed contours (isotachs)
- Useful to identify the location of jetstreams, bands of exceptionally strong winds that encircle the Earth in the middle latitudes. Also in 250 and 200mb maps.
- Jetmaxs(jetstreaks) directly influence the development of cyclones. Their location, intensity and relationship to the position of the waves should be examined using 300, 250, and 200mb maps.


8700
8820
8940
9060
9180
9300
9420
9540
9660
9660
300 mb
1200 UTC
5 Dec 01
0
20
40
60
80
100
120
140
160
Wind (knots)

# Summary

- Review and be able to interpret surface station models on weather maps
- Lines of constant…
  - Pressure: Isobars
  - Temperature: Isotherms
  - Dew Point: Isodrosotherm
- Upper air charts use height at constant pressure rather than pressure at constant height
- Useful upper-air levels
  - 850 mb (1.5 km)—fronts, clouds, moisture, snow or not…
  - 500 mb (5.5 km)---waves, cyclone motion
  - 300 mb (9 km)---Jet streams, cyclone& severe weather formation
- Vorticity:
  - Tendency for air to rotate around a vertical axis
  - Concentrated in circular storms and shear zones
  - Key to understnding complicated weather
  - “Vorticity meter”