Weather vs. Climate
**Definition of Weather**

*Weather*: Condition of the atmosphere at a particular time and place.

Comprised of:

- **Air temperature**: Degree of hotness or coldness
- **Air pressure**: Force of the air above
- **Humidity**: Amount of water vapor in the air
- **Clouds**: Water droplets (liquid) or ice crystals (solid) above the surface
- **Precipitation**: Water that falls from clouds and reaches ground
- **Visibility**: Farthest distance one can see.
- **Wind**: Horizontal movement of air
Surface Station Model (U.S.)

Notes: Temperature and Wind

Stations outside U.S. use degrees Celsius for temperature.

Wind barb direction reverses in southern hemisphere.
Surface Station Model (U.S.)

Notes: Pressure

Leading 10 or 9 is not plotted for surface pressure

Greater than 500 = 950 to 999 mb

Less than 500 = 1000 to 1050 mb

988 → 998.8 mb
200 → 1020.0 mb
Sky Cover, Weather Symbols on a Surface Station Model

### Total Sky Cover
- No clouds
- Less than one-tenth or one-tenth
- Two-tenths or three-tenths
- Four-tenths
- Five-tenths
- Six-tenths
- Seven-tenths or eight-tenths
- Nine-tenths or overcast with openings
- Completely overcast
- Sky obscured

### Common Weather Symbols
- **•** Light rain
- **••** Moderate rain
- **•••** Heavy rain
- **••••** Light snow
- **•••••** Moderate snow
- **••••••** Heavy snow
- **•••••••** Light drizzle
- **••••••••** Ice pellets (sleet)
- **•••••••••** Freezing rain
- **••••••••••** Freezing drizzle
- **•••••••••••** Drifting or blowing snow
- **••••••••••••** Dust storm
- **•••••••••••••** Fog
- **••••••••••••••** Haze
- **•••••••••••••••** Smoke
- **••••••••••••••••** Thunderstorm
- **•••••••••••••••••** Hurricane
- **••••••••••••••••••** Rain shower
- **•••••••••••••••••••** Snow shower
- **••••••••••••••••••••** Showers of hail
- **•••••••••••••••••••••** Drifting or blowing snow
- **••••••••••••••••••••••** Dust storm
- **•••••••••••••••••••••••** Fog
- **••••••••••••••••••••••••** Haze
- **•••••••••••••••••••••••••** Smoke
- **••••••••••••••••••••••••••** Thunderstorm
- **•••••••••••••••••••••••••••** Hurricane
Surface Pressure Tendency

Pressure Tendency

- ↑ Rising, then falling
- → Rising, then steady; or rising, then rising more slowly
- → Rising steadily or unsteadily
- ✔ Falling or steady, then rising; or rising, then rising more quickly
- — Steady, same as 3 hours ago
- ✔ Falling, then rising, same or lower than 3 hours ago
- → Falling, then steady; or falling, then falling more slowly
- → Falling steadily, or unsteadily
- ↑ Steady or rising, then falling; or falling, then falling more quickly

Barometer now higher than 3 hours ago

Barometer now lower than 3 hours ago
Wind Speed

How to read:

Half barb = 5 knots

Full barb = 10 knots

Flag = 50 knots

1 knot = 1 nautical mile per hour = 1.15 mph

________ = ______ knots
Wind direction

NORTHERLY
From the north

WESTERLY
From the west

SOUTHERLY
From the south

EASTERLY
From the east
Eastern Colorado Snowstorm 12-29-06

(From UCAR RAP website)
LIMON, COLORADO

AMARILLO, TEXAS
Limon, Colorado (LIC)

Weather conditions

STATION IDENTIFIER
Limon, Colorado (LIC)

Weather conditions

Temperature: 21°F
Limon, Colorado (LIC)

**Weather conditions**

**Temperature**: 21°F  
**Dewpoint**: 18°F
Limon, Colorado (LIC)

Weather conditions

Temperature: 21°F
Dewpoint: 18°F
Pressure: Not available
Limon, Colorado (LIC)

Weather conditions

Temperature: 21°F
Dewpoint: 18°F
Pressure: Not available
Sky conditions: Overcast
Limon, Colorado (LIC)

Weather conditions

**Temperature**: 21°F  
**Dewpoint**: 18°F  
**Pressure**: Not available  
**Sky conditions**: Overcast  
**Wind**: North-northwesterly at 30 knots, gusting to 34 knots.
Limón, Colorado (LIC)

**Weather conditions**

- **Temperature**: 21°F
- **Dewpoint**: 18°F
- **Pressure**: Not available
- **Sky conditions**: Overcast
- **Wind**: North-northwesterly at 30 knots, gusting to 34 knots.
- **Precipitation**: Moderate Snow
Limon, Colorado (LIC)

Weather conditions

Temperature: 21°F
Dewpoint: 18°F
Pressure: Not available
Sky conditions: Overcast
Wind: North-northwesterly at 30 knots
Precipitation: Moderate
Snow
Visibility: Quarter mile
Amarillo, Texas (AMA)

Weather conditions

Temperature: [Red]

Dewpoint: [Green]

Pressure: [Purple]

Sky conditions: [Orange]

Wind: [Blue]

Precipitation: [Pink]

Visibility:
Front Symbols

- Cold front (surface)
- Warm front (surface)
- Occluded front (surface)
- Stationary front (surface)
- Squall line
- Trough (trop)
- Ridge
- Dryline

Fronts mark the boundary between air masses with different characteristics.

Typically where “interesting” weather happens.
Weather Map: 12-29-06

(COLD AIR)

(WARM AIR)

(UCAR RAP website)
What about what is happening above the ground?
Upper Air Measurements

Weather balloons, or *radiosondes*, sample atmosphere up to 10 mb.

They measure:
- Temperature
- Moisture
- Pressure

They are tracked to get winds using global positioning satellites (GPS)
North American Upper Air Network

Observations typically taken twice per day at the same time (00 and 12 GMT)

Note the scarcity of observations over Mexico—and the Mexican government may even cut these!
Upper Air Sounding
(Skew T Log P Diagram)

Denver Sounding on 12-29-06

Gives a graphical display of information from the radiosonde:

Temperature (Red)
Dewpoint (Green)
Winds (right side)

Note the changes in temperature and moisture with height.

UCAR RAP website
Upper Air Station Model
(At specific pressure level)

Upper-Air Model (500 mb)

- Temperature (°C)
- Height of pressure surface in meters with first 3 digits given (5640 meters)
- 12 hour height change in meters (04 equals 40 m)
- Sign indicating whether height is rising or falling
- Dew point depression (difference between air temperature and dew point, °C)
- Wind speed (58–62 knots)
- Wind direction (from the southwest)
500-mb Map: 12-29-06
500-mb Conditions at Denver (DEN)
500-mb Conditions at Denver (DEN)

Height of 500-mb Surface: 5620 m
500-mb Conditions at Denver (DEN)

Height of 500-mb Surface: 5620 m
Temperature: -20° C
500-mb Conditions at Denver (DEN)

Height of 500-mb Surface:
5620 m
Temperature: -20° C
Dewpoint: -22° C

DEWPOINT DEPRESSION
500-mb Conditions at Denver (DEN)

Height of 500-mb Surface: 5620 m
Temperature: -20° C
Dewpoint: -22° C
Winds: Southeasterly at 25 knots
Practice it yourself for today’s weather using the UCAR RAP website…

www.rap.ucar.edu/weather
Definition of Climate

Climate: The statistical characteristics of weather elements over a given period of time.

Some examples:

• Seasonal or yearly average rainfall in the U.S.
• Dominant patterns of sea surface temperatures (e.g. El Niño)
• Daily average temperature at a weather station
• Variability of snowfall
Major factors for AZ:

1. __________

2. __________

Note the dependence of rainfall with elevation.
El Niño Southern Oscillation (ENSO)
AVERAGE DECEMBER – FEBRUARY [3-month] PRECIPITATION RANKINGS DURING ENSO EVENTS
Based on 1895–1997

CLIMATE PREDICTION CENTER, NOAA
Tucson Snowfall

TUCSON WSD AP, ARIZONA (028820)
Period of Record: 7/1/1948 to 4/30/2000

Snowfall (in.)

Day of Year

Western Regional Climate Center
Some Good Places on the Web for Climate Information

National Weather Service
www.nws.noaa.gov

Climate Diagnostics Center, Boulder, CO
www.cdc.noaa.gov

Climate Prediction Center, NCEP, Camp Springs, MD
www.cpc.noaa.gov

Western Regional Climate Center, Reno, NV
www.wrcc.dri.edu

National Climate Data Center, Asheville, NC
www.ncdc.noaa.gov
Summary of Lecture 3

Defined the difference between weather and climate.

*Weather* is the condition of the atmosphere at a particular time and place: temperature, pressure, humidity, clouds, precipitation, visibility and wind. Be familiar with how each of these is defined.

Looked at surface and upper air station models (as well as weather symbols) and how to interpret them to diagnose the weather. Went through an example of a snowstorm in Colorado in late December.

*Climate* is the statistical characteristics of weather elements over a given period of time. Several examples of climate data were presented for various time and space scales.
Reading Assignment

Ahrens, Chapter 2, pp. 27-35 (8th ed.)

pp. 29-37 (9th ed.)