

2007

Upper Air Plots

STORM Project

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Upper Air Observations
Level 2
Teacher's Pages
<http://www.uni.edu/storm/level2>

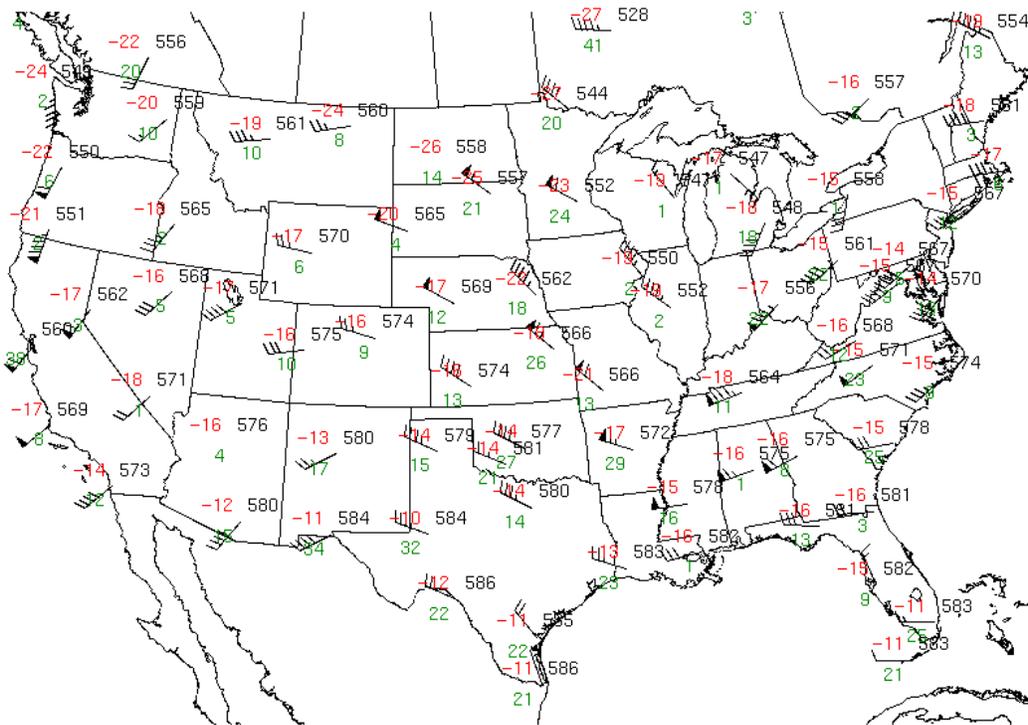
Objectives: Students will study air patterns at three different levels of the troposphere..

National Science Education Standards: As a result of activities in grades 5-8, all students should develop an understanding of: abilities necessary to do scientific inquiry, properties and changes of properties in matter, understandings about science and technology, and structure of the earth system.

As a result of their activities in grades 9-12, all students should develop an understanding of Energy in the earth System: The sun is the major external source of energy; Heating of earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents; Global climate is determined by energy transfer from the sun at and near the earth's surface. This energy transfer is influenced by dynamic processes such as cloud cover, the earth's rotation, and static conditions such as the position of mountain ranges and oceans.

Engage:

1. What do you remember about plotting weather data on surface weather maps?
2. Do you remember how wind direction and wind speed are represented?
3. Where do you plot temperature and dew point temperature?



The STORM Project

1200Z APR 03 2006 500 mb Station Plot

Explore:

Have students look at the 500 mb Station Plot. Ask them to state the information that is given by the map and plots.

Explain:

The data plotted on the U.S.A. map is data collected above earth's surface by radiosondes or "weather balloons." These balloons are released twice a day from selected National Weather Service Offices around the United States, and the world. Radio transmitters on the weather balloons transmit data back to receiving stations.

Read the following explanations of how meteorologists plot this so-called "upper-air" data on weather maps.

Plotting Upper-Air Observation Elements.

The image below is an example of an upper air station plot on a constant-pressure map (at 500 millibars).

Upper Air Station Model

| | | | |
|--|---|--------------------------|---|
| Temp (C) Dewpoint (C) depression |  | Height (m) Wind (kts) | Data at Pressure Level - 500 mb Temp -5 °C, dewpoint -12 °C, wind from S at 75 knots, height of level 564 <u>0</u> m |
|--|---|--------------------------|---|

The maps of upper-air observations or plots are called constant-pressure maps because the air temperature, dew point depression, wind speed and wind direction plotted on a particular map are all measured at the same pressure level above each station. For instance, on a 500 millibar constant-pressure map, the height at which the 500-mb pressure value is found is different for each station. Thus, instead of doing an analysis of pressure on an upper-air map, an analysis of **height** is done, much as a topographic map. Common upper-air (constant-pressure) maps include: 850-mb, 700-mb, 500-mb, 300-mb, 250-mb, 200-mb.

Standard pressure levels and approximate heights:

| Pressure | Approximate Height | | Approximate Temp | |
|-----------|--------------------|----------|------------------|-------|
| Sea level | 0 m | 0 ft | 15 C | 59 F |
| 1000 mb | 100 m | 300 ft | 15 C | 59 F |
| 850 mb | 1500 m | 5000 ft | 5 C | 41 F |
| 700 mb | 3000 m | 10000 ft | -5 C | 23 F |
| 500 mb | 5000 m | 18000 ft | -20 C | -4 F |
| 300 mb | 9000 m | 30000 ft | -45 C | -49 F |
| 200 mb | 12000 m | 40000 ft | -55 C | -67 F |
| 100 mb | 16000 m | 53000 ft | -56 C | -69 F |

The following describes the procedure for plotting the observed data.

Air Temperature. Air Temperature is plotted to the upper left of the station circle (to the nearest whole degree Celsius).

Height of the Constant-Pressure Surface above sea level is plotted to the upper right of the station circle. The height of the constant-pressure surface is plotted to the nearest whole meters on the 850- and 700-millibar map and to the nearest tens of meters on the 500 millibar map and those maps above 500 mb. Only three digits are plotted. On the 850- and 700-hPa map, the thousands digit is dropped. On the 500-mb map and above the units digit is dropped.

Dew point depression) is the difference between the air temperature and the dew point. The dew point is always less than, or the same as the air temperature. The dew point depression is plotted to the lower left of the station circle (to the nearest whole degree Celsius).

Wind Speed and Direction are plotted in the same manner as surface weather station models.

1. Select a station from a location nearest you and write down the following information:

- a) Air Temperature _____
- b) Dew Point Depression _____
- c) Height _____
- d) Wind Speed _____
- e) Wind Direction _____

2. Look at the upper air data provided below for Oakland, California. Make plots for the 850 mb, 700, mb, 500 mb, and 300 mb levels. (PRES is pressure, HGHT is height in meters, TMPC

is temperatures in Celsius, DWPC is dew point depression, DRCT is wind direction in compass degrees, and SKNT is wind speed in knots.)

| PRES | HGHT | TMPC | DWPC | DRCT | SKNT |
|--------|---------|--------|--------|--------|-------|
| 850.00 | 1411.00 | 3.20 | 1.10 | 200.00 | 21.00 |
| 700.00 | 2957.00 | -6.50 | -8.40 | 180.00 | 33.99 |
| 500.00 | 5500.00 | -23.70 | -41.70 | 180.00 | 60.99 |
| 300.00 | 9010.00 | -50.50 | -58.50 | 210.00 | 83.99 |

Extend:

1. At the activity website, look at the 850 mb, 500 mb, and 300 mb maps. Compare the temperatures, wind speed and wind direction for several different cities on each map.
2. What do you notice about the 500 mb heights for locations where it is colder than other cities?
3. What do you notice about dew point temperatures as altitude above a given city increases?
4. Compare the 500 mb map for five days in a row. Describe the changes you see over the five days.

For Further Inquiry:

How do upper air patterns change during a five-day period? Challenge students to design an investigation to answer this or any other question they have about upper air patterns.

Evaluate:

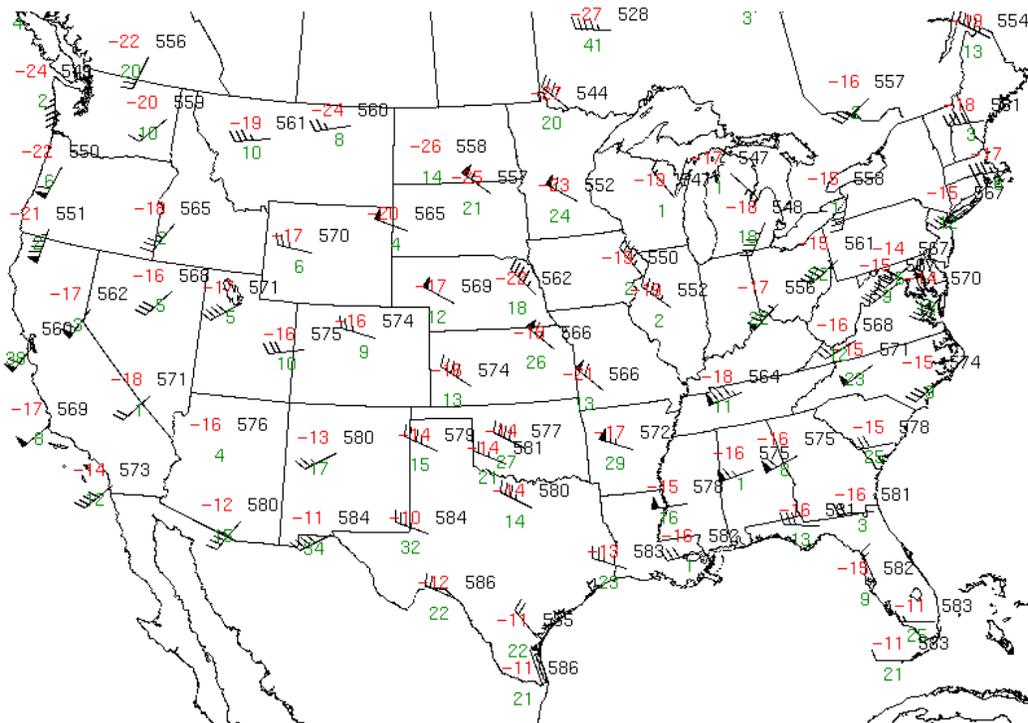
1. Collect and evaluate student sheet..
2. Have students write a lab report with data analysis and conclusions.

**Upper Air Observations
Level 2
Student Sheets**
<http://www.uni.edu/storm/level2>

Objectives: Students will study air patterns at three different levels of the troposphere..

Engage:

4. What do you remember about plotting weather data on surface weather maps?
5. Do you remember how wind direction and wind speed are represented?
6. Where do you plot temperature and dew point temperature?



The STORM Project

1200Z APR 03 2006 500 mb Station Plot

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| Dewpoint (C) depression | | Wind (kts) | |

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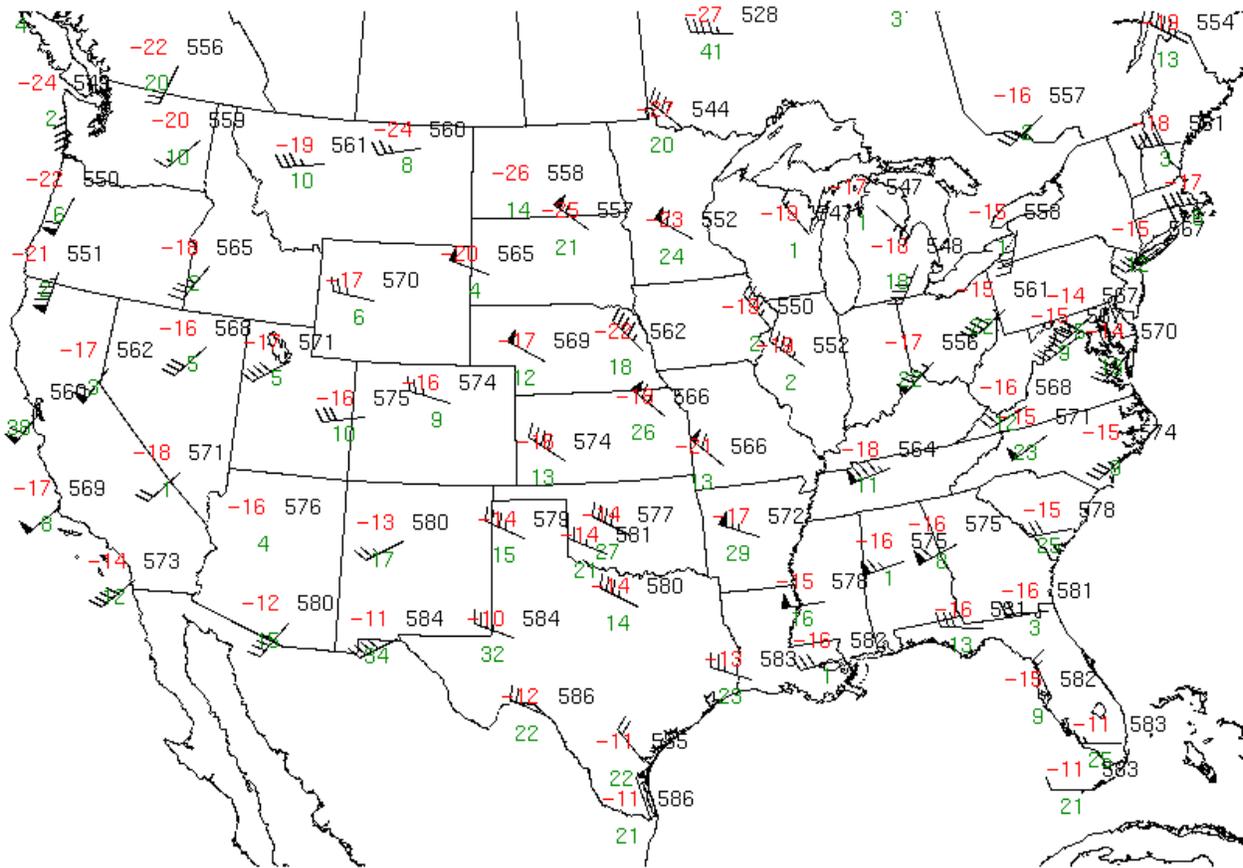
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