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Exercise 15  
Pre-Lab Video



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# 15

## LAB EXERCISE

# Midlatitude Cyclones and Hurricanes

### Lab Exercise and Activities

#### SECTION 1

##### Idealized Weather Map Analysis

Analyze the idealized weather map in **Figure 15.1** to determine general weather conditions at the stations noted. Using the weather symbols presented in Lab Exercise 14 and a physical geography text dealing

with air masses and weather, complete the following information for six cities: wind direction and speed (if any), air pressure, air temperature, dew-point temperature, state of the sky, and weather type (if any).

1. Boise, Idaho—label the weather conditions you think are occurring. Describe the dominant air mass and relative humidity.

**Boise, Idaho:** continental polar air, clear, dry air, and possibly very cold, high pressure, winds calm, stable conditions, and some air stagnation for urban areas in valleys.

2. Denver, Colorado—label the weather conditions you think are occurring. Describe the dominant air mass and relative humidity.

**Denver, Colorado:** Recent passage of a cold front and transition to continental polar air, possible rain changing to snow, wind shift to northwesterly, relative humidity dropping, air pressure rising, and winds shifting.

3. Wichita, Kansas—label the weather conditions you think are occurring. Describe the dominant air mass and relative humidity.

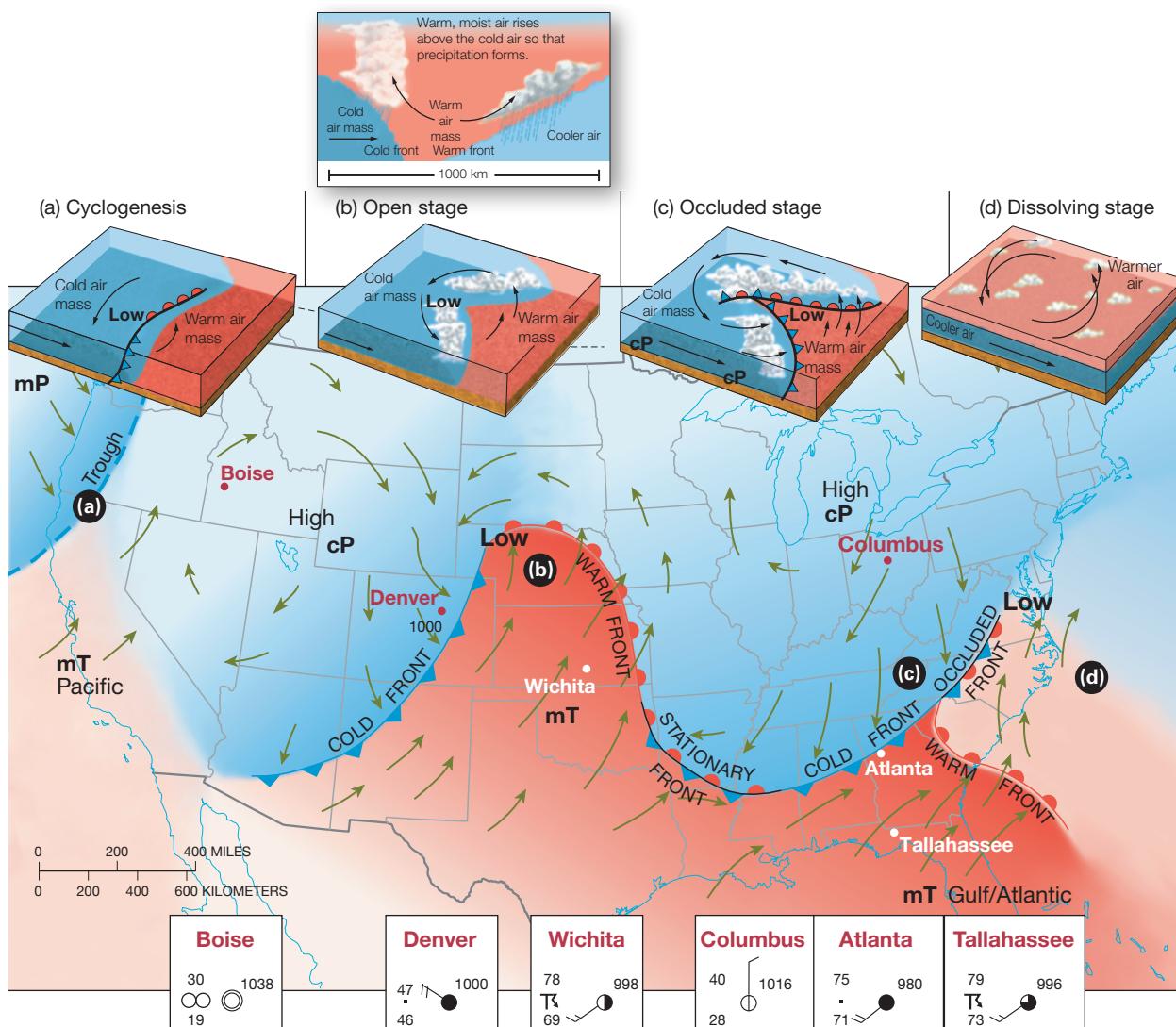
**Wichita, Kansas:** maritime tropical air (not as intense as along the Gulf Coast), warm air and afternoon convection thunderstorms, southwesterly winds, sky half covered with clouds.

4. Columbus, Ohio—label the weather conditions you think are occurring. Describe the dominant air mass and relative humidity.

**Columbus, Ohio:** continental polar air, low relative humidity and low air temperatures, stable conditions, northeasterly winds, mostly clear sky, possible wind-chill conditions.

5. Atlanta, Georgia—label the weather conditions you think are occurring. Describe the dominant air mass and relative humidity.

**Atlanta, Georgia:** maritime tropical air, high relative humidity and high air temperatures, southwesterly winds, rain, sky covered with clouds.



**▲ Figure 15.1** Idealized weather map—assume afternoon conditions

- Tallahassee—label the weather conditions you think are occurring. Describe the dominant air mass and relative humidity.

**Tallahassee, Florida: maritime tropical air, high relative humidity and high air temperatures, southwesterly winds, thunderstorms, sky 3/4 covered with clouds**

- If you were a weather forecaster in Tallahassee, and needed to prepare a forecast for broadcast covering the next 24 to 48 hours, what would you say? Begin with current conditions you listed in number 3 above. List the conditions that you would expect for Tallahassee for 24 and 48 hours. Assume that the system is moving eastward at 25 kph (15 mph) and note the scale on the map.

- a) 24 hours:

**mT air mass, high relative humidity and air temperatures, southwesterly winds, thunderstorms, sky 3/4 covered with clouds**

- b) 48 hours:

**mT air mass, high relative humidity and air temperatures, southwesterly winds, thunderstorms, sky 3/4 covered with clouds**

## SECTION 2

- Which stage of cyclogenesis is this storm in? Explain your answer.

***It is in the open stage because occlusion hasn't happened yet.***

- Use a red colored pencil or pen and crosshatch the region that is within 600 km of the warm front or cold front and is under the mT air mass. Consider those stations with dew-point temperatures above 55°F as being under the mT air mass. Use a blue colored pencil and crosshatch the region within 600 km of the warm front or cold front and under the cP air mass. Consider those stations with dew-point temperatures below 55°F as being under the cP air mass.
- The lines for the warm and cold fronts are drawn for you. Identify the warm front and draw a series of red semicircles on the side of the line that the mT air mass is moving toward. Identify the cold front and draw a series of blue triangles on the side of the line that the mP air mass is moving toward.
- Use a purple colored pencil or pen to draw an outline of the region(s) experiencing rain. Review the rain symbols found in Figure 14.1a. Use an atlas to find the name of the city experiencing the heaviest rain. What is the name of that city? What kind of air mass is over it?
- Use an atlas to identify the following weather stations:

- Which station has the highest wind speed? What is the name of the city, and what is the wind speed?

***30 kts in Rapid City, SD***

- Which station has the driest air? Look for the station with the lowest dew point. What is the name of the city, and what is the dew point? Which type of air mass is over this city?

***22 degrees, Cut Bank, Montana, cP***

- Which station has the most humid air? Look for the station with the highest dew point. What is the name of the city, and what is the dew point? Which type of air mass is over this city?

***Miami, FL, 75 degrees, mT***

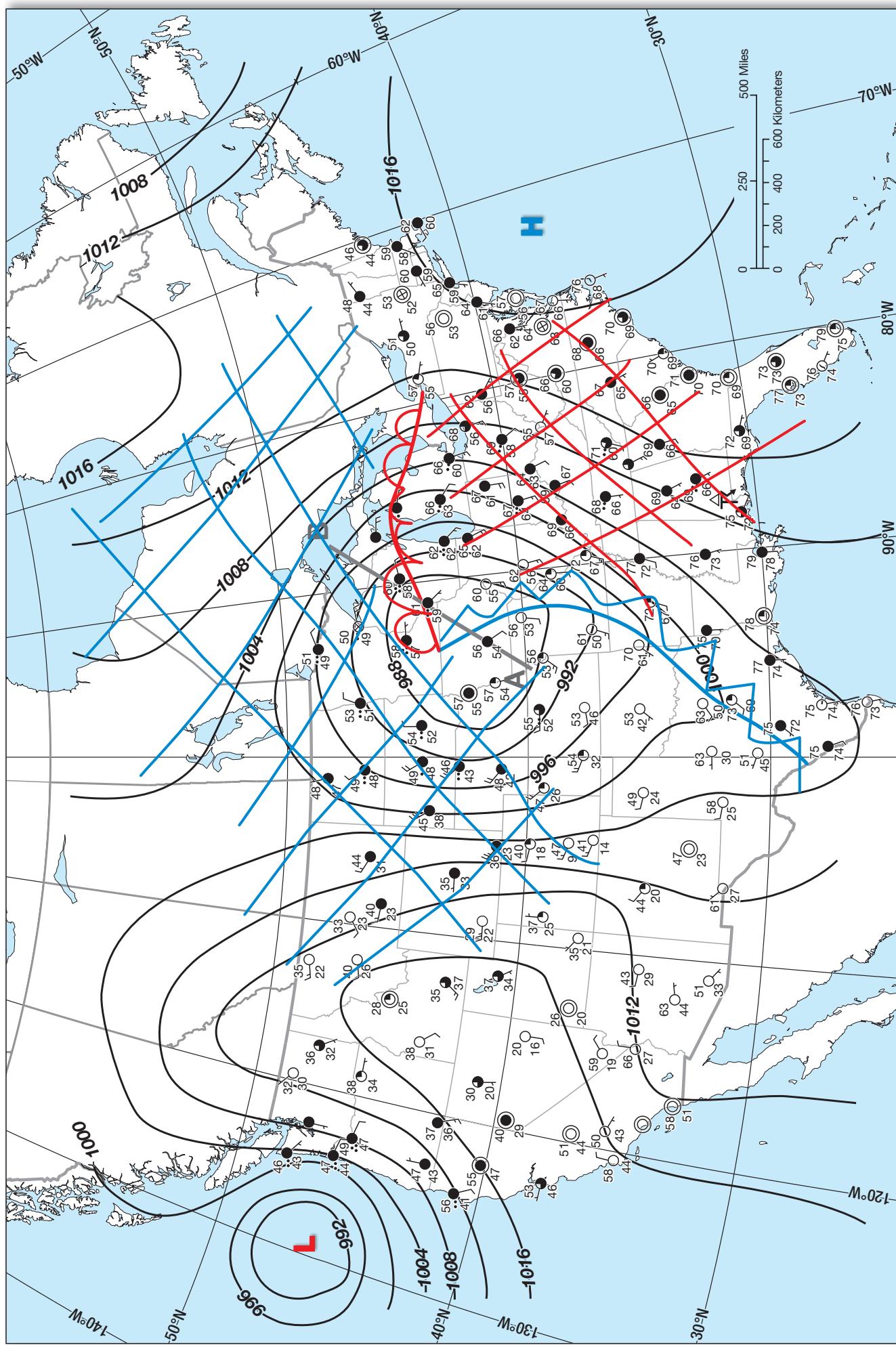
- What were the current conditions in Springfield, Illinois, on October 18, 2007? List the temperature, dew-point temperature, wind speed and direction, and air pressure. Which type of air mass was overhead?

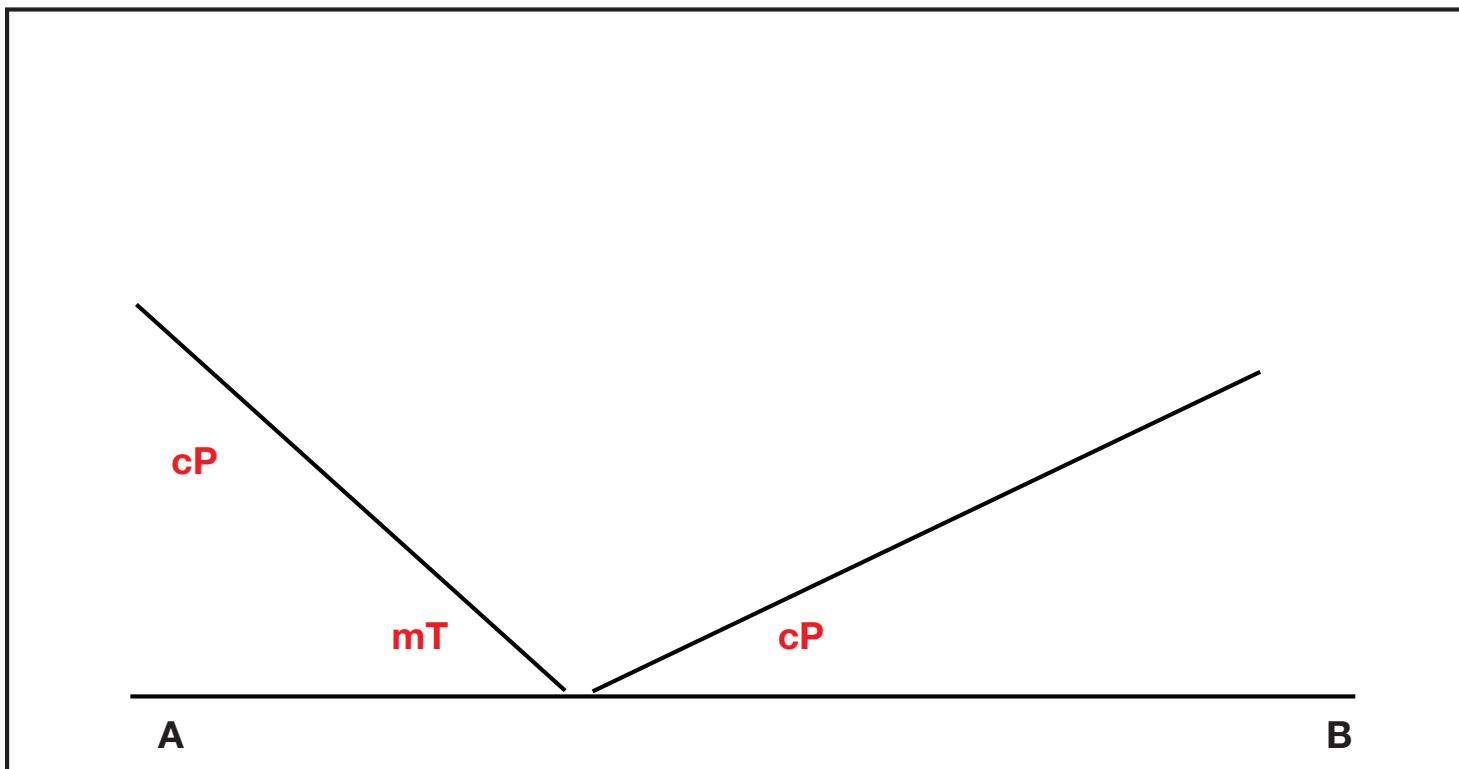
***Temp 61°, dew-point 50°, wind 15 kts from SW, air pressure 992 mb, mT air mass***

- On October 19, 2007, the storm had moved 600 km (360 mi) eastward. Estimate what the conditions were in Springfield, Illinois, on that day. List what you think the temperature, approximate dew-point temperature, and wind speed and direction were on October 19. Which type of air mass was overhead?

***Temp 54°, dew-point 32°, wind 15 kts from NW, air pressure 997 mb, cP air mass***

- Figure 15.2 shows a view of the storm from above. There is a transect line from point A in southern Iowa to point B in Lake Superior. In the space below, draw a cross section (side view) of the cold front and the warm front that corresponds to the transect line drawn from A to B.





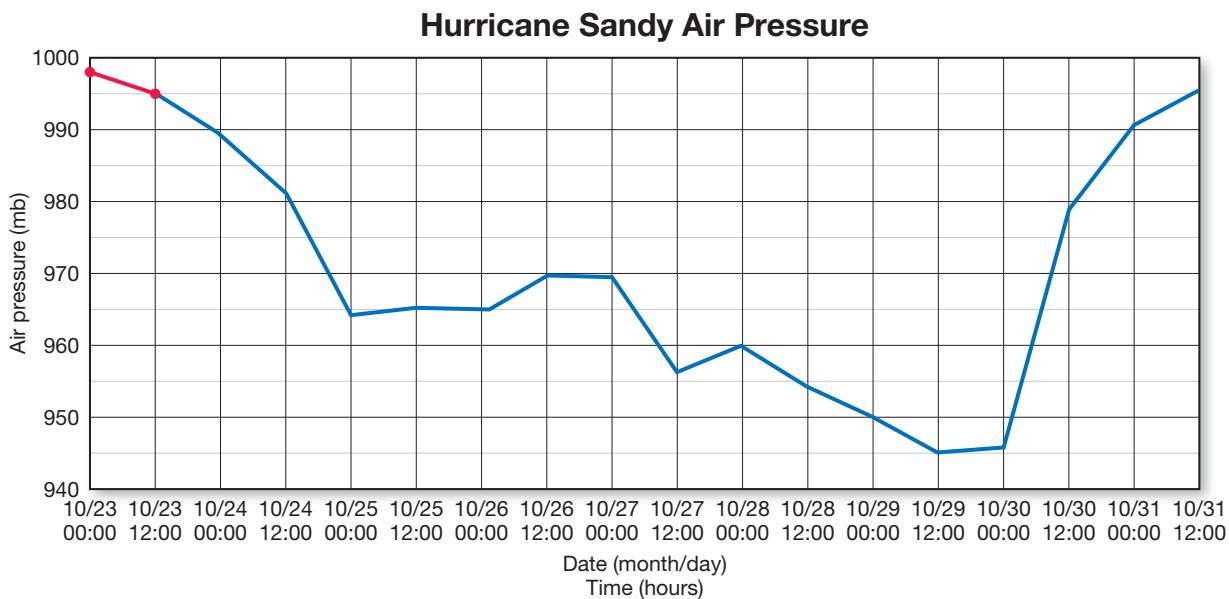
▲ Cross section of a midlatitude cyclone

## SECTION 3

### Hurricanes, Typhoons, and Cyclones

#### Hurricane Sandy

1. Plot Sandy's storm track, using the data in **Figure 15.3**, then fill in the SST (sea-surface temperature) for each of the data points in the spaces provided. The first eight points are plotted for you. Use **Table 15.1** to determine Sandy's storm classification and fill in the category.
2. Use colored pencils to plot on the graphs below the wind speed for each day in kmph, the central pressure in mb, and the SST in °C for each day. The first two days are plotted for you.



- Estimate the distance traveled using 100 km per degree of longitude and latitude. How far did Sandy travel from 00 UTC on the 27th to 00 UTC on the 28th? 00 UTC on the 28th to 00 UTC on the 29th? 00 UTC on the 29th to 00 UTC on the 30th?

**300 km. 340 km. 560 km**

- What was Sandy's maximum recorded wind speed? How fast was it traveling on that day, in kilometers per hour? What was the maximum wind speed in the right-front quadrant (wind speed combined with traveling speed)? What would the total wind speed have been in the left-rear quadrant (wind speed minus traveling speed)?

**175 kmh. 24.5 kmh. 199.5 kmh, 150.5 kmh**

- Mark the location on the map with the highest wind speed. On what day did that occur? What was the water temperature on that day?

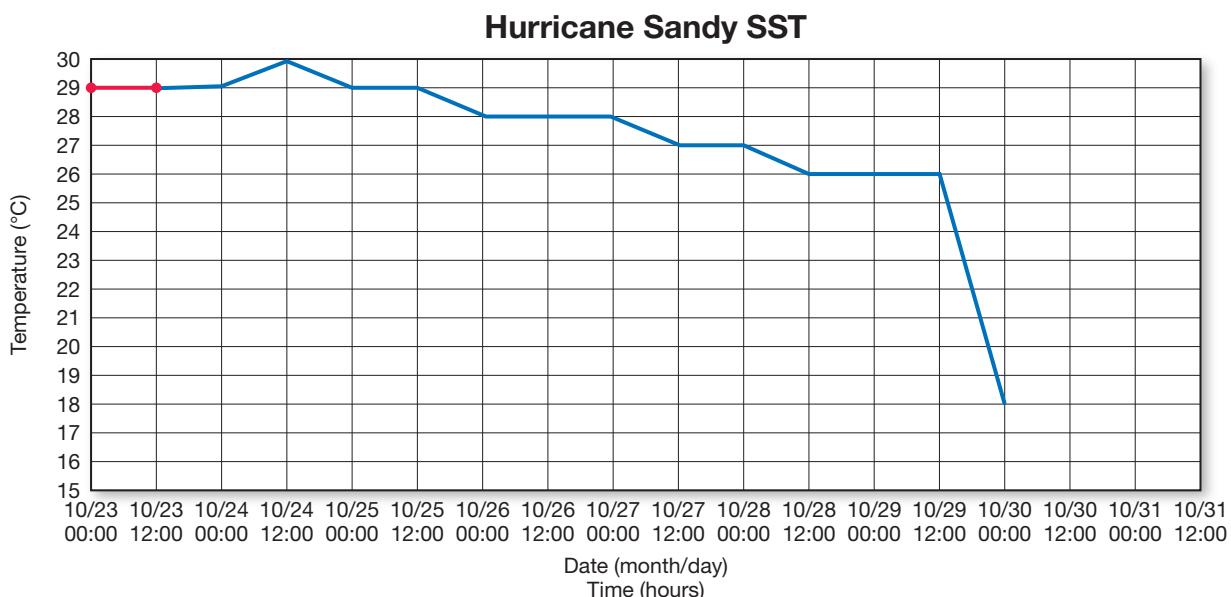
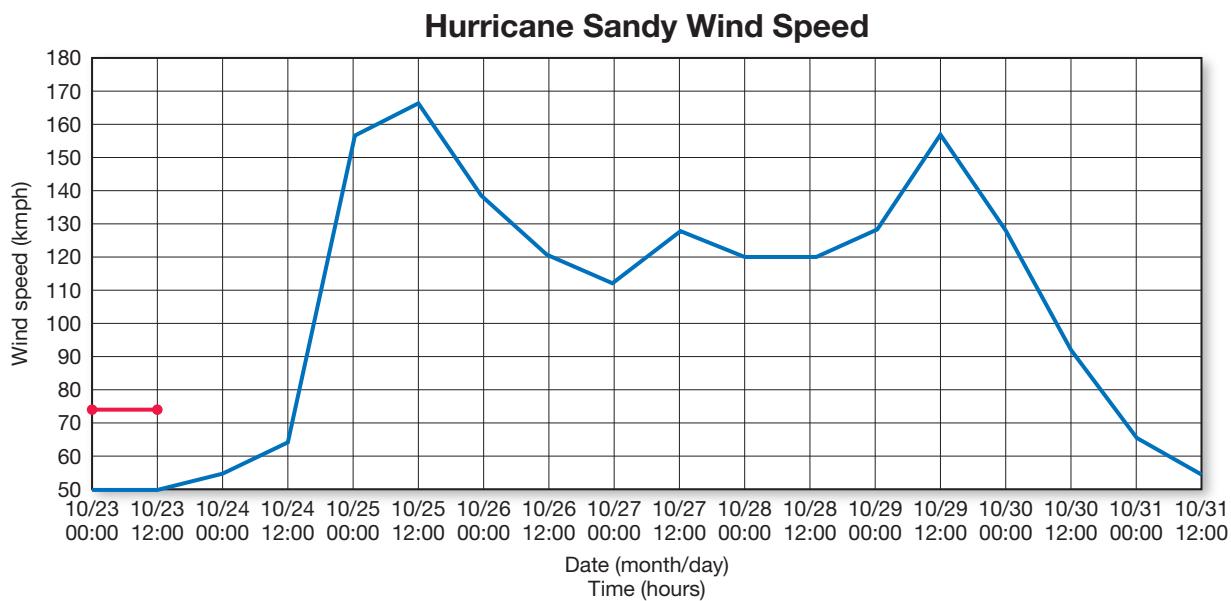
**175 kmh on the 25th, SST 29°**

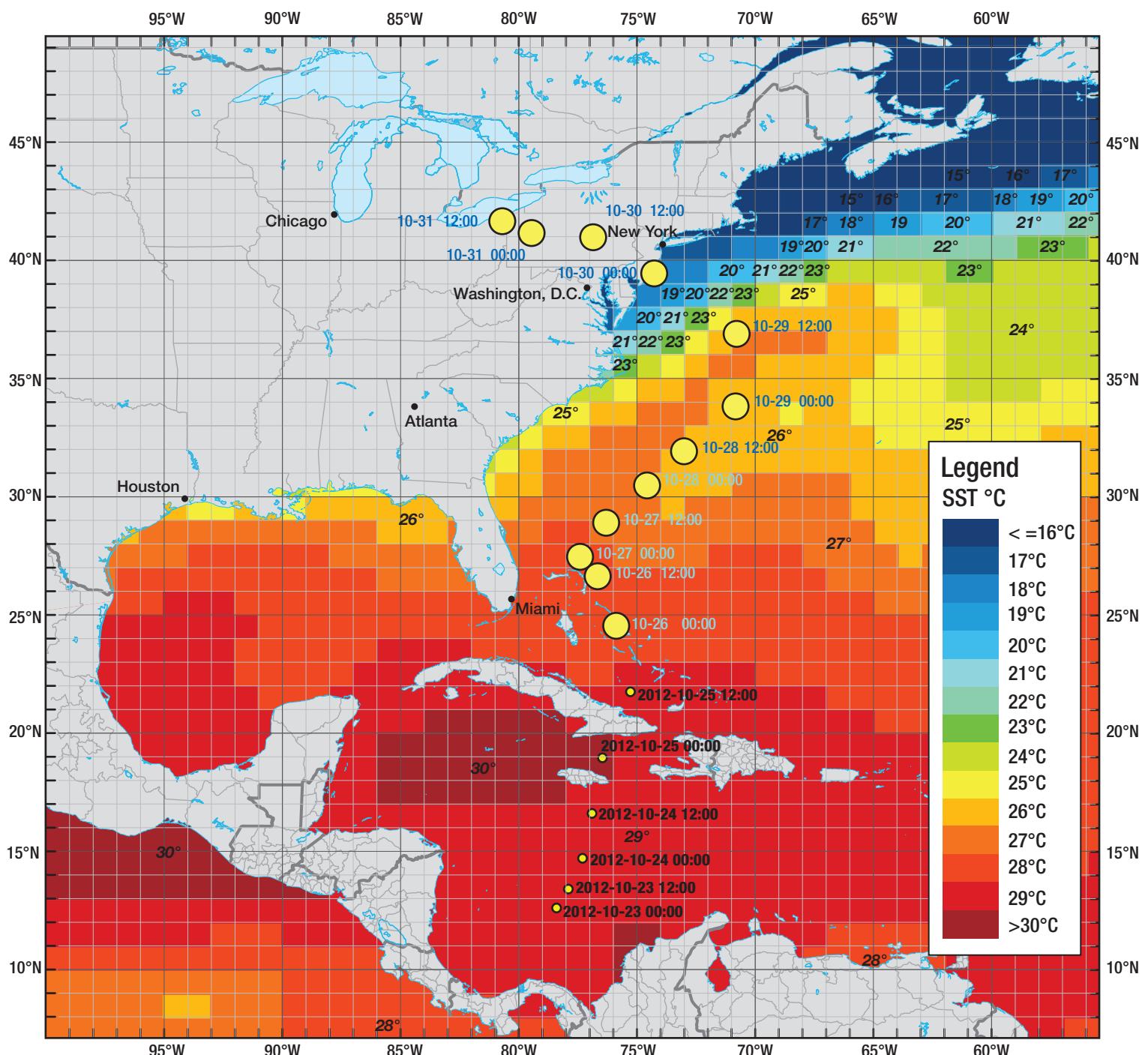
- How much did the central pressure drop from normal sea level pressure?

**49 mb**

- For hurricanes to form, the water temperature must be at least 26°C (79°F). What was the warmest water that Hurricane Sandy passed over? Coldest water? Describe the relationship between water temperature, wind speed, and the central air pressure of Hurricane Sandy. How did these factors from the 24th through the 25th compare with the 28th through the 29th?

**Warmest water 29°, coldest 17°. Higher wind speeds recorded with higher SSTs**





▲ Figure 15.3 Hurricane Sandy

Date Time (UTC)	Category	Latitude	Longitude	Wind Kmh	Mb	SST
2012-10-23 00:00	TD	12.6	-78.4	40	998	29°
2012-10-23 12:00	TD	13.4	-77.9	40	995	29°
2012-10-24 00:00	TD	14.7	-77.3	55	990	29°
2012-10-24 12:00	TS	16.6	-76.9	65	981	30°
2012-10-25 00:00	H2	18.9	-76.4	157	964	29°
2012-10-25 12:00	H2	21.7	-75.5	175	966	29°
2012-10-26 00:00	H1	24.8	-75.9	139	965	28°
2012-10-26 12:00	H1	26.4	-76.9	120	970	28°
2012-10-27 00:00	TS	27.5	-77.1	111	969	28°
2012-10-27 12:00	H1	28.8	-76.5	129	956	27°
2012-10-28 00:00	H1	30.5	-74.7	120	960	27°
2012-10-28 12:00	H1	32.0	-73.0	120	954	26°
2012-10-29 00:00	H1	33.9	-71.0	129	950	26°
2012-10-29 12:00	H2	36.9	-71.0	157	945	26°
2012-10-30 00:00	Extra-tropical	39.5	-74.5	129	946	18°
2012-10-30 12:00	Extra-tropical	40.1	-77.8	92	978	na
2012-10-31 00:00	Extra-tropical	40.7	-79.8	65	992	na
2012-10-31 12:00	Extra-tropical	41.5	-80.7	55	995	na

8. Briefly summarize the relationship between SST and hurricane strength. What are the implications of this on future hurricanes? What advice would you give to coastal planners regarding future development of coastal areas on the U.S. east coast?

***SST and wind speed are apparently linked. Higher SSTs correlate with higher wind speeds. As SSTs increase, storm power will also increase, leading to more destructive storms. Development should be curtailed in low-lying coastal areas vulnerable to storm surge and flooding.***