Section 12.4

Objectives

- **Analyze** a basic surface weather chart.
- **Distinguish** between digital and analog forecasting.
- **Describe** problems with long-term forecasts.

Review Vocabulary

model: an idea, system, or mathematical expression that represents an idea

New Vocabulary

station model
isobar
isotherm
digital forecast
analog forecast

Weather Analysis and Prediction

MAIN Idea **Several methods are used to develop short-term and long-term weather forecasts.**

Real-World Reading Link It is usually easier to predict what you will be doing later today than what you will be doing a week from now. Weather predictions also are easier for shorter time spans than for longer time spans.

Surface Weather Analysis

Newspapers, radio and television stations, and Web sites often give weather reports. These data are plotted on weather charts and maps and are often accompanied by radar and satellite imagery.

Station models After weather data are gathered, meteorologists plot the data on a map using station models for individual cities or towns. A **station model** is a record of weather data for a particular site at a particular time. Meteorological symbols, such as the ones shown in **Figure 12.17,** are used to represent weather data in a station model. A station model allows meteorologists to fit a large amount of data into a small space. It also gives meteorologists a uniform way of communicating weather data.

Plotting station model data Station models provide information for individual sites. To plot data nationwide and globally, meteorologists use lines that connect points of equal or constant values. The values represent different weather variables, such as pressure or temperature. Lines of equal pressure, for example, are called **isobars,** while lines of equal temperature are called **isotherms.** The lines themselves are similar to the contour lines—lines of equal elevation—that you studied in Chapter 2.

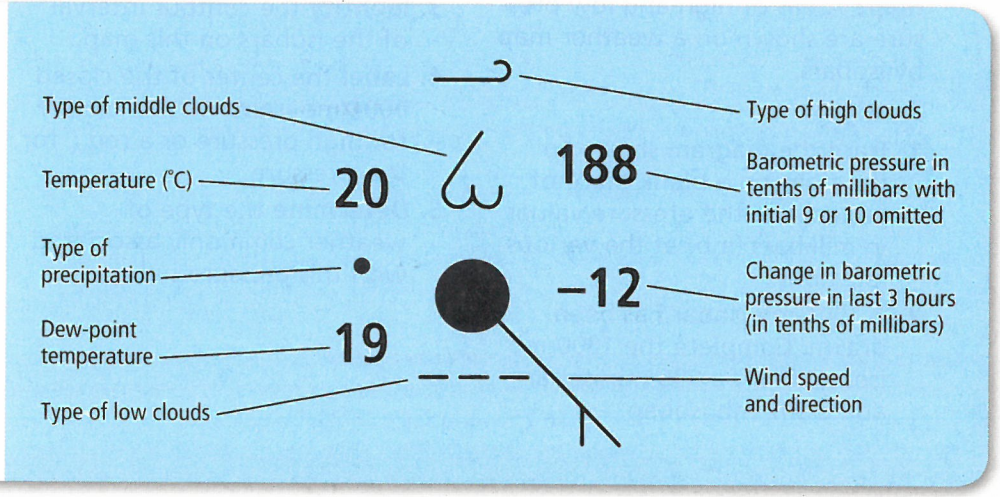


Figure 12.17 A station model shows temperature, wind direction and speed, and other weather data for a particular location at a particular time.
Explain *the advantage of using meteorological symbols.*

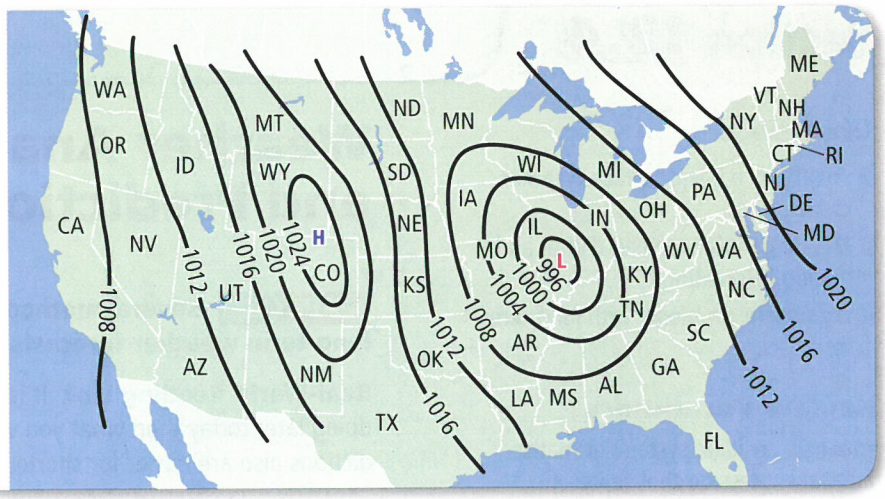


Figure 12.18 The weather map shows isobars and air pressure data for the continental United States.

Determine *where on the weather map you would expect the strongest winds.*

Interpreting station model data

Recall that inferences about elevation can be made by studying contour intervals on a map. Inferences about weather, such as wind speed, can be made by studying isobars and isotherms on a map. Isobars that are close together indicate a large pressure difference over a small area, which means strong winds. Isobars that are far apart indicate a small difference in pressure and light winds. As shown in **Figure 12.18,** isobars also indicate the locations of high- and low-pressure systems. Combining this information with that of isotherms helps meteorologists to identify frontal systems.

Using isobars, isotherms, and station-model data, meteorologists can analyze current weather conditions for a particular location. This is important because meteorologists must understand current weather conditions before they can forecast the weather.

PROBLEM-SOLVING LAB

Interpret a Scientific Illustration

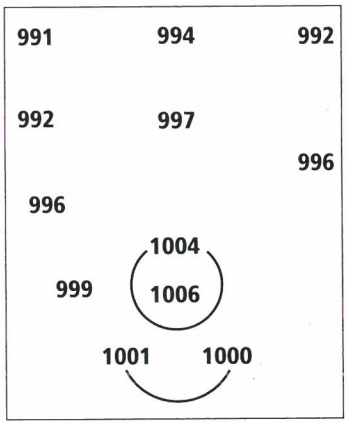
How do you analyze a weather map? Areas of high and low pressure are shown on a weather map by isobars.

Analysis

1. Trace the diagram shown to the right on a blank piece of paper. Add the pressure values in millibars (mb) at the various locations.
2. A 1004-mb isobar has been drawn. Complete the 1000-mb isobar. Draw a 996-mb isobar and a 992-mb isobar.

Think Critically

3. **Identify** the contour interval of the isobars on this map.
4. **Label** the center of the closed 1004-mb isobar with a blue *H* for high pressure or a red *L* for low pressure.
5. **Determine** the type of weather commonly associated with this pressure system.



Types of Forecasts

A meteorologist, shown in **Figure 12.19,** must analyze data from different levels in the atmosphere, based on current and past weather conditions, to produce a reliable forecast. Two types of forecasts are digital forecasts and analog forecasts.

Digital forecasts The atmosphere behaves like a fluid. Physical principles that apply to a fluid, such as temperature, pressure, and density, can be applied to the atmosphere and its variables. In addition, they can be expressed as mathematical equations to determine how atmospheric variables change over time.

A **digital forecast** is created by applying physical principles and mathematics to atmospheric variables and then making a prediction about how these variables will change over time. Digital forecasting relies on numerical data. Its accuracy is related directly to the amount of available data. It would take a long time for meteorologists to solve atmospheric equations on a global or national scale. Fortunately, computers can do the job quickly. Digital forecasting is the main method used by present-day meteorologists.

Reading Check **State** the relationship between the accuracy of a digital forecast and the data on which it is based.

Analog forecasts Another type of forecast, an **analog forecast,** is based on a comparison of current weather patterns to similar weather patterns from the past. Meteorologists coined the term *analog forecasting* because they look for a pattern from the past that is similar, or analogous, to a current pattern. To ensure the accuracy of an analog forecast, meteorologists must find a past event that had similar atmosphere, at all levels and over a large area, to a current event.

The main disadvantage of analog forecasting is the difficulty in finding the same weather pattern in the past. Still, analog forecasting is useful for conducting monthly or seasonal forecasts, which are based mainly on the past behavior of cyclic weather patterns.

Short-Term Forecasts

The most accurate and detailed forecasts are short term because weather systems change directions, speeds, and intensities over time. For hourly forecasts, extrapolation is a reliable forecasting method because small-scale weather features that are readily observable by radar and satellites dominate current weather.

One- to three-day forecasts are no longer based on the movement of observed clouds and precipitation, which change by the hour. Instead, these forecasts are based on the behavior of larger surface and upper-level features, such as low-pressure systems. A one- to three-day forecast is usually accurate for expected temperatures, and for when and how much precipitation will occur. For this time span, however, the forecast will not be able to pinpoint an exact temperature or sky condition at a specific time.

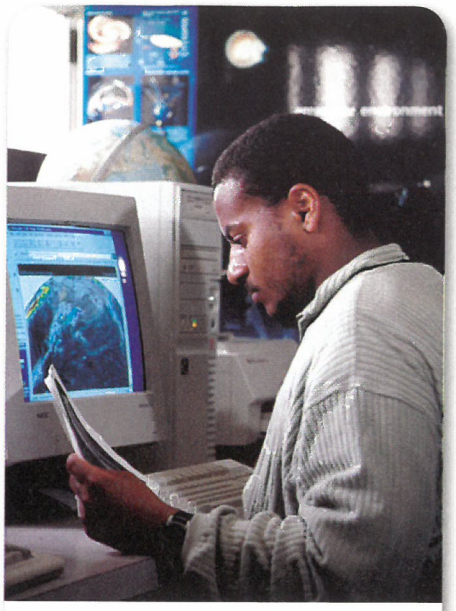


Figure 12.19 This meteorologist is analyzing data from various sources to prepare a weather forecast.

VOCABULARY

ACADEMIC VOCABULARY

Extrapolation
(ihk stra puh LAY shun)
the act of inferring a probable value from an existing set of values
Short-term weather forecasts can be extrapolated from data collected by radar and satellites.

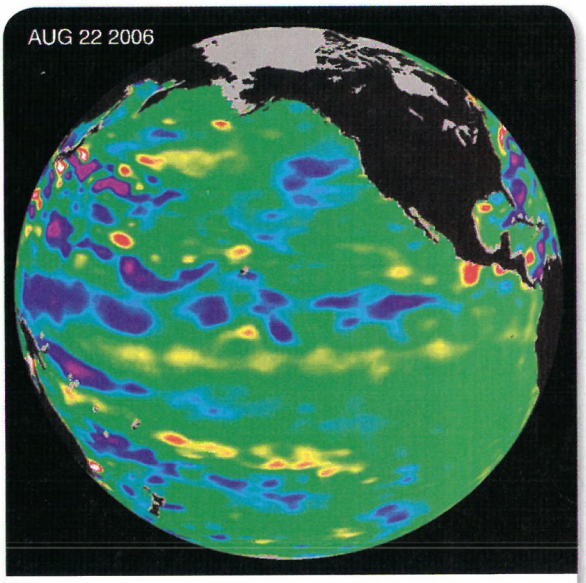


Figure 12.20 La Niña occurs when stronger-than-normal trade winds carry the colder water (blue) from the coast of South America to the equatorial Pacific Ocean. This happens about every three to five years and can affect global weather patterns.

Long-Term Forecasts

Because it is impossible for computers to model every variable that affects the weather at a given time and place, all long-term forecasts are less reliable than short-term forecasts. Recall that features on Earth's surface affect the amount of thermal energy absorbed at any location. This affects the pressure at that location, which affects the wind. Wind influences cloud formation and virtually all other aspects of the weather in that location. Over time, these factors interact and create more complicated weather scenarios.

Meteorologists use changes in surface weather systems based on circulation patterns throughout the troposphere and lower stratosphere for four- to seven-day forecasts. They can estimate each day's weather but cannot pinpoint when or what specific weather conditions will occur. One- to two-week forecasts are based on changes in large-scale circulation patterns. Thus, these forecasts are vague and are based mainly on similar conditions that have occurred in the past.

Forecasts for months and seasons are based mostly on weather cycles or patterns. These cycles, such as the one shown in **Figure 12.20,** can involve changes in the atmosphere, ocean currents, and solar activity that might occur at the same time. Improvements in weather forecasts depend on identifying the influences of the cycles involved, understanding how they interact, and determining their ultimate effect on weather over longer time periods.

Section 12.4 Assessment

Section Summary

- A station model is used to plot different weather variables.
- Meteorologists plot lines on a map that connect variables of equal value to represent nationwide and global trends.
- Two kinds of forecasts are digital and analog.
- The longer the prediction period, the less reliable the weather forecast.

Understand Main Ideas

1. MAIN Idea **Describe** the methods used for illustrating weather forecasts.
2. **Identify** some of the symbols used in a station model.
3. **Model** how temperature and pressure are shown on a weather map.
4. **Compare and contrast** analog and digital forecasts.
5. **Explain** why long-term forecasts are not as accurate as short-term forecasts.

Think Critically

6. **Assess** which forecast type—digital or analog—would be more accurate for three days or less.

MATH in Earth Science

7. Using a newspaper or other media sources, find and record the high and low temperatures in your area for five days. Calculate the average high and low temperatures for the five-day period.

Earth Science online Self-Check Quiz glencoe.com