

EXERCISE 11

AIR PRESSURE

Objective: To introduce the standard weather map station model and to study pressure patterns shown on maps with isobars.

Reference: Hess, Darrel. *McKnight's Physical Geography*, 10th ed., pp. 97–99.

AIR PRESSURE

The **pressure of air** is the force exerted by the atmosphere on a surface. Gravity pulls the gases of the atmosphere toward the surface of Earth, and so atmospheric pressure is sometimes thought of as the “weight” of the air, but this is somewhat simplistic. Atmospheric pressure is a force exerted in all directions.

FACTORS INFLUENCING AIR PRESSURE

Many factors influence air pressure. The pressure, density, and temperature of the air are all closely interrelated. If one factor changes, the other two tend to change also. We can, however, make a few generalizations about the kinds of conditions that tend to produce either high or low pressure near the surface.

The following are generalizations and *not* absolute laws. In practice, however, most surface pressure cells can be explained by the dominance of one of these four conditions:

1. Ascending (rising) air tends to produce **low pressure** near the surface. Lows caused by strongly rising air are sometimes called **dynamic lows**.
2. Warm surface conditions tend to produce low pressure near the surface. Lows caused by warm surface conditions are sometimes called **thermal lows**.
3. Descending (subsiding) air tends to produce **high pressure** near the surface. Highs produced by strongly descending air are sometimes called **dynamic highs**.
4. Cold surface conditions tend to produce high pressure near the surface. Highs produced by cold surface conditions are sometimes called **thermal highs**.

MEASURING AIR PRESSURE

There are several measurement systems used to describe air pressure. While most television and newspaper weather reports use **inches of mercury** (the height of a column of mercury in a liquid barometer), the most common unit of pressure measurement used in meteorology is the **millibar**. The millibar (mb) is a measure of force per unit area. The definition of one millibar is the force of 1000 dynes per square centimeter (1 dyne is the force required to accelerate 1 gram of

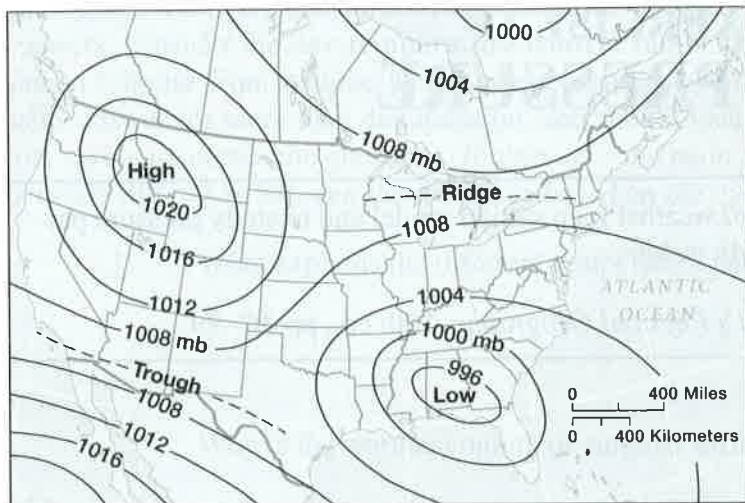


Figure 11-1: Isobar map showing areas of high and low pressure. (From McKnight and Hess, *Physical Geography*, 9th ed.)

mass 1 centimeter per second per second). (In some countries air pressure is described with the *kilopascal* [kPa; 1 kPa = 10 mb].)

For comparison, the average sea-level pressure is 29.92 inches of mercury, which is equivalent to 1013.25 mb. We are generally interested in relative differences in pressure. For example, at the surface, 1032 mb would usually represent relatively high pressure, while 984 mb would represent relatively low pressure (equivalent to 30.47 inches and 29.06 inches of mercury respectively).

ISOBARS

Differences in pressure can be mapped with isolines called **isobars**. Isobars are lines that connect points of equal atmospheric pressure. Figure 11-1 shows a region where areas of high and low pressure have been mapped with isobars. Note that a **ridge** is an elongated area of relatively high pressure, while a **trough** is an elongated area of relatively low pressure.

THE STATION MODEL

We are now going to introduce the **station model** and the standardized system of data presentation that is used on weather maps around the world. In its bare form, a station model is a circle on a map that shows the location of a weather station (in our scale of analysis, usually a city). Various weather data are then plotted in a specific form, and in a specific location, around (and within) this circle.

In this Lab Manual, we will be using an abbreviated form of the station model, introducing new elements in subsequent exercises. However, we will follow standard station model protocol in the placement of each data element.

Temperature: The current surface temperature of a station is written to the upper left of the circle. In the example below, the temperature is 65° Fahrenheit. Note that neither the degree symbol (°) nor an "F" (for Fahrenheit) is included:

65
○

Pressure: Current surface pressure is written to the upper right of the circle. In the example below, the surface pressure is 970.2 mb:

970.2
○

On standard weather maps, however, the notation for pressure is abbreviated. To save space, the first 9 or 10 is left off, and the decimal point is removed. So, in a standard station model, a pressure of 970.2 mb would be written:

702
○

While 1035.6 mb would be written:

356
○

To rewrite these pressures in their full form, simply add the decimal point, and then decide if adding a 9 or 10 makes more sense. Usually this is easy, since surface pressures typically range from about 960.0 mb to 1050.0 mb. For example, given the pressure shown on the following station model:

237
○

First add the decimal point: “_23.7”; then add a 10: “1023.7 mb.” Adding a 9 usually would not make sense, because 923.7 mb is lower than expected for a typical surface pressure (a quick way to decide whether to add a 9 or a 10 is to choose the number that makes the pressure value closest to 1000 mb).

Occasionally, the pressure may be higher or lower than is typically encountered—the extremely low pressure associated with the eye of a hurricane is one example of this. In such cases, you will have to decide by the context of nearby stations if adding a 9 or a 10 makes more sense.