Nicole Giuliano

Focus*on*Fog

Have you ever woken up in the morning and not been able to see your mailbox (or other nearby objects)? Have you noticed that a couple of hours after sunrise, everything is often clear again? Fog typically forms overnight, sometimes hiding objects that are only a few feet away from you. It also usually disappears quickly after the sun rises and warms the earth, creating little air circulations that make the fog droplets evaporate.

Fog forms when the air cools to the temperature at which water vapor begins to condense into tiny water droplets (this is called the dewpoint temperature). This is also how clouds form, so fog is actually a cloud that is near the ground. If the air temperature is within 5 degrees Fahrenheit of the dewpoint temperature and the air is getting colder, fog may form. This is why fog is more common at night—the air near the ground cools when the sun is not warming the surface of the earth.

For the most commonly occurring fog, ideal conditions usually include nearly calm winds, clear skies, and a low-lying location (such as a river valley). Not surprisingly, the foggiest place in the United States, Cape Disappointment, Washington, is near sea level. This foggy spot is located at the mouth of the Columbia River, and it averages 2,556 hours of heavy fog each year.

There are four main types of fog: radiation, advection, evaporation (or mixing), and upslope fog. Cooling of the Earth's surface produces the first type of fog—radiation (or ground) fog. As mentioned above, the ground cools at night since the sun is not warming it. While the ground cools, the temperature of the air just above the ground cools to near the dewpoint temperature. This "meeting" of the air temperature and dewpoint temperature leads to water vapor condensing into tiny liquid droplets, and produces radiation fog. Most of the fog that we experience in Oklahoma is radiation fog.

Figure 1 - Radiation Fog

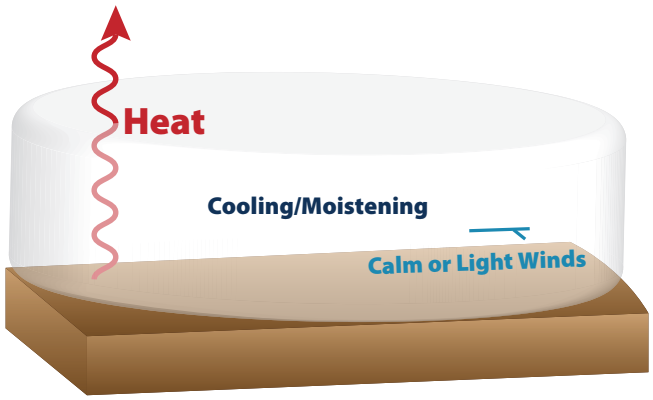
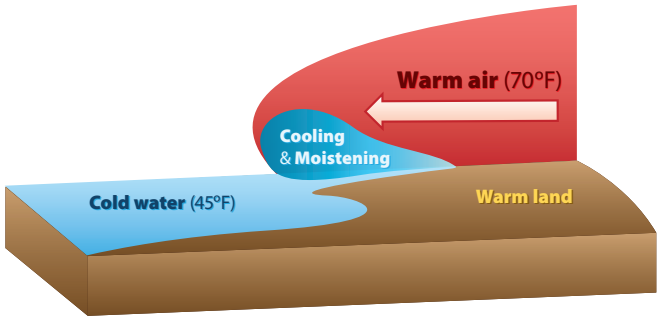


Figure 2 - Advection Fog



The second type of fog, advection fog, occurs when warm, moist air blows over a cold surface. The warm air is cooled from below and the air temperature drops down to near the dewpoint temperature, creating fog. Unlike radiation fog, advection fog requires wind and can form even when winds are strong. An example of classic advection fog is the fog that often forms near the Golden Gate Bridge in San Francisco. Though it is more rare than radiation fog, advection fog can also be found in Oklahoma. When warm, moist air from the Gulf of Mexico moves over cold land, it can produce advection fog that slowly rolls into the state.

Continued >>

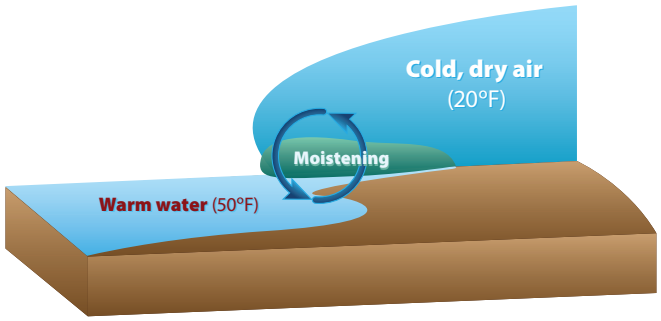
Evaporation fog, the third fog type, happens when moist air mixes with cold, dry air to form a low-lying cloud. An example is steam fog, which forms when cold air blows over warm water, such as a lake. Water takes a lot longer to warm up or to cool down than the land, so it is not unusual in the winter for lakes to have a warmer temperature than the nearby land. Liquid water evaporates from the body of water, becoming water vapor (a gas) and increasing the moisture in the cold, relatively dry air mass. More moisture in the air increases the dewpoint temperature, which means that the air temperature does not have to fall much to reach the dewpoint temperature. Since warm, moist air is less dense ("lighter") than cold, dry air, the warm air rises into the cold air, which gives the appearance of "steam." Steam fog occurs occasionally on Oklahoma roads, over lakes and streams, and in cold air near fronts.

The fourth and final type, upslope fog, forms as moist air flows up a hill or mountain. Moist air is forced upward, so that it rises, expands, and cools. If its air temperature reaches the dewpoint temperature, fog forms. A dramatic upslope fog can sometimes be seen on the eastern side of the Rockies, where there is a large change in elevation. However, even less steep terrain features, such as the Wichita Mountains of Oklahoma, can be sufficient for upslope fog formation.

In general, fog is considered to be a nuisance, especially when it comes to driving. When a car enters a foggy area, a driver should slow down due to reduced visibility. Unfortunately, there is a high risk that a careless driver may rear-end the slow-moving vehicle because he or she cannot see the vehicle ahead. To increase visibility and to reduce the amount of scattered light reflecting back, a driver should use the low beam rather than the high beam lights. Fog is also a hazard for ships and airplanes, which have difficulty navigating in low visibility conditions. In fact, to avoid accidents, many airlines delay or sometimes even cancel flights when fog becomes too dense.

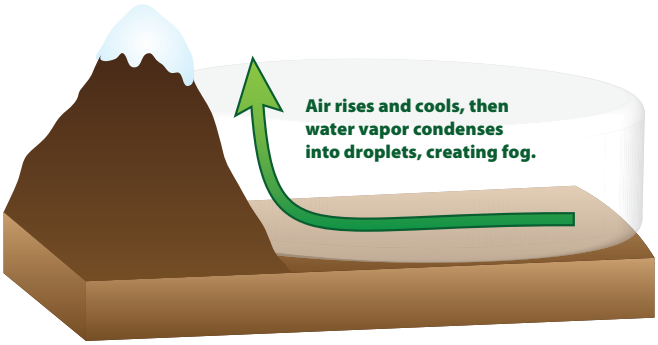
Classroom >>

Figure 3 - Evaporation Fog



The warm air over the water and the cold air above mix, and finally end up at nearly the same temperature. At the same time, the air becomes saturated as the dewpoint temperature rises due to the increase in moisture.

Figure 4 - Upslope Fog



Nicole Giuliano

Questions

1. How many days does Cape Disappointment experience heavy fog?
   (Hint: convert 2,556 hours to days. Remember, there are 24 hours in 1 day.)

2. Look at the fog graphic "Mean Annual Number of Days with Fog" on the following page.
   What geographical locations experience 25 or more days of fog per year?

3. Why do you think these areas have so much fog?
   (Hint: look at the ideal fog conditions as well as the four major types of fog.)

4. According to the fog graphic, how many days of fog per year does your part of the state see (e.g., central Oklahoma)? Is it more often or less often than you expected?

5. Why do you think that Arizona, western New Mexico, and southeastern Nevada have fewer fog days?

6. What is one possible reason why there is so much fog near the Appalachians, but not as much near the Rocky Mountains?

Answers on page 7

Classroom (Fog Map) >>

Figure 1 - Mean Annual Number of Days with Fog (< .25 mile visibility)