

## Precipitation

Precipitation is defined as any form of water that falls from the atmosphere and hits the surface. The kinds of precipitation vary from fog, which is tiny droplets of liquid water, to hail, which can grow to the size of baseballs in large thunderstorms. In general, the size and state of the water that falls from a cloud is related to the kind of uplift process at work. The following is a description of the major types of precipitation we experience in Colorado.

### Rain

Rain is defined as liquid water that falls from clouds. The drops we see falling are clearly different sizes. The size of a rain drop is an indicator of how much uplift is occurring in the atmosphere. Small drops like fog are an indication of weak lifting in the atmosphere, while giant drops we see in a thunderstorm are the product of powerful lifting forces that push the raindrop well above the bottom of the the cloud.

A raindrop forms when water vapor condenses on a small piece of dust suspended in the atmosphere. This occurs above the base of the cloud where the relative humidity is above 100%. The relative humidity of air inside a cloud is always greater than 100% and is referred to as super saturated. Inside the cloud, water is changing from its gas state back to liquid because of the cool temperatures. Once the drop forms, it continues to grow inside the cloud until it becomes too heavy for the rising air to support it. Once the drop falls out of the cloud, it immediately starts to evaporate as it falls to earth. This process of liquid water forming from water vapor occurs in all clouds. The drops, however, do not always fall to the surface as rain. In many cases the water is evaporated before it hits the surface. This process of rain evaporating as it falls is referred to as **Virga**.

The longer a drop of water remains inside of the cloud, the larger it becomes. In general, the height of a cloud is a reflection of the lifting force pushing air upward. In thunderstorms we see powerful convective uplift that often pushes water drops well above the lifting condensation level. In these tall clouds, raindrops can rise in updrafts of 100 miles per hour or more. This explains why the drops that fall from very tall thunderstorm clouds are often huge.

Each type of uplift process generates raindrops of varying sizes. Frontal uplift is generally weaker than convective uplift, so the raindrops are smaller. Fog is formed at the surface in a condition with very weak lifting. The drops form very near the surface and gently fall back to earth without growing much at all. In winter when the temperature above the surface is often below freezing, the dew point is usually below the freezing temperature of water.

### Snow

Snow is a particular type of precipitation where the dew point of the air mass is below the freezing temperature of water. In this case when the air is cooled to the dew point temperature, the water vapor forms snowflakes rather than raindrops. In other words, water condenses to a solid state from vapor essentially skipping the liquid state.

The size of snowflakes is an indication of the temperature and humidity of the the air. In the middle of winter when the air is extremely cold and dry, it cannot hold much water vapor. When the air rises and forms snowflakes that are very small, this reflects a small amount of water vapor in the air. In spring as the air temperature rises, it can hold more water vapor, so we see larger flakes of snow in April than we do in January.

In general, snow formed at higher elevations is dryer and, therefore, lighter. This is why Colorado is such a popular ski destination. The snow formed in our mountains is produced under very cold conditions due to the low pressure. The cold air cannot hold much moisture, resulting in very light "powder" snow our resorts are famous for.

## Hail

All of us who live in Douglas County are familiar with hail. It regularly falls from larger thunderstorms that form during the spring and summer months along the foothills. Hail is frozen rain that forms when raindrops are pushed above the freezing point in the atmosphere. We commonly see hail associated with large thunderstorms that have powerful convective lifting from the surface.

Hail stones are formed as water is pushed high into clouds. Once a raindrop is frozen, it falls back toward the surface of the earth. Often the hail is pushed aloft again as it falls, causing the hail stone to gather another coat of ice. By this circulation process, hail stones can become very large before they become too heavy to be supported by the rising air. At this point, the hail stone falls to the surface. The number of times a hail stone circulates through the cloud can be determined by cutting the hail stone open and counting the number of rings. Each ring indicates a trip above the freeze line in the cloud.

## Fog

Fog is formed when water is evaporated into air that is already saturated. The result is a cloud formed on the surface of the earth. Fog is formed in a number of different ways. We will examine a few common types of fog.

1. Steam Fog - This type of fog is very common over water during winter months. It can be seen rising off the surface of water when the air above the water is cold. The water vapor evaporates into the air above the liquid water and then quickly condenses to form steam.
2. Valley Fog - This type of fog is formed in the bottom of valleys during winter months. Most valleys have a river or water source in their bottom which evaporates moisture into the air. During winter, cold air from the mountains surrounding the valley flows downhill due to its high density. As the cold air moves downhill, it accumulates in the bottom of the valley. Water vapor in the bottom of the valley is cooled by the plunging air and condenses to form fog along the valley floor.
3. Radiation Fog - This is the fog we see form near the surface on extremely cold nights in winter. The earth's surface radiates enough heat to evaporate small amounts of water vapor into the air right near the surface. As the air rises above the surface, it condenses in the cold air to form fog near the surface. This fog always forms within a few feet of the surface and remains within a few feet of the surface.

4. Jungle Fog - This type of fog forms above trees after a rain shower. The fog is formed as air rising from the surface evaporates water from the trees as it rises. The tree limbs are wet, providing a source of moisture. Once the air is above the trees, it encounters cooler air which causes the water vapor to condense and form fog.

5. Maritime Fog - This fog forms along the coast of oceans or large lakes at night. Maritime fog forms when water vapor evaporated from the ocean moves over the cool land at night. The land cools the moist air, causing fog to form near the shore. This type of fog generally forms in the early morning hours when the air over the land is coldest. After the sun rises in the morning, the land quickly heats the air above it, causing the fog to evaporate by mid-day.

