

Fire Weather and Fire Behavior Impacts from Clouds Chart

John Saltenberger

Predictive Services Northwest Interagency Coordination Center

Safety on the fireline can be improved by awareness of the current fire environment as well as anticipation of potential changes. Paying attention to the sky can help the firefighter do both. The NWS/Predictive Services cloud chart depicts sky signs of interest for wildland firefighters that are valuable tools in revealing the atmosphere's current state as well as foretelling potential changes.

Clouds occur when moisture in the atmosphere condenses into visible droplets or ice crystals. This usually occurs when moist air becomes cooled by lifting. The shape and texture of clouds reveals much about whether the lifting process has been gradual and gentle or rapid and potentially violent.

Atmospheric stability describes the tendency for upward and downward motion of air. Unstable conditions are revealed by billowing cumulus-type clouds and virga that signal strong vertical motion. The taller and more dramatic the cumulus buildups, the stronger the vertical motion is likely to be. Strong vertical motion is a concern for firefighters because it can result in sudden, erratic, gusty winds at the surface with potentially serious consequences on the fireline.

Clouds that reveal variations of instability in the atmosphere:

Cumulus (several varieties): Weak instability. Normally not a concern for firefighters. However, when cumulus continues growing, firefighters are advised to keep an eye on the buildups due to the potential for sudden downdrafts and gusty winds.

Alto Cumulus (several varieties): Upper atmosphere instability and possible weather change. These indicate increasing moisture and instability with the potential for thunderstorms.

Cumulonimbus: Very unstable. Fully developed mature thunderstorms contain extreme vertical motion and the strong likelihood of gusty, erratic winds that can arise suddenly miles away from the cloud buildup. Localized wind gusts over 100 mph are possible with very strong thunderstorms along with lightning, **virga**, and hail. Very strong thunderstorms may also be accompanied by **shelf clouds** or **tornados**. Clearly, cumulonimbus clouds portend many hazards to the firefighter exposed on the fireline.

Pyrocumulus: Very unstable. Pyrocumulus clouds grow above ongoing wildfires drawing energy from the heat of combustion and condensation of moisture in the fire's convection column. A white-capped pyrocumulus cloud is a concern for firefighters for the same reason as a thunderstorm: Strong, gusty erratic winds can arise suddenly in the vicinity of a pyrocumulus. **Virga**, light raindrops, and even some lightning is possible with well developed pyrocumulus clouds.

Firewhirl: Very unstable. Firewhirls occur due to extreme vertical motion in a wildfire's convection column. Be aware of the potential for gusty erratic winds when firewhirls are observed.

A stable atmosphere generally tends to limit violent vertical motion. As a result, cloud buildups during stable conditions tend to be wider and flatter, possibly covering much of the sky. It should be noted that strong general winds are possible during stable conditions depending upon the weather pattern. The firefighter should pay attention to the fire weather forecast and keep an eye on the sky for indicators of potential severe conditions that can dominate the fire environment.

Clouds that indicate a stable atmosphere:

Stratus (several varieties): Stable and moist. Stratus clouds can cover much of the sky and blot out sunlight or even bring rain. Stratus clouds tend to mean higher humidity and decreased fire behavior. Normally not a concern for firefighters.

Cirrostratus (several varieties): High level stratus clouds formed of ice crystals. Cirrostratus clouds are normally not a concern for firefighters. However, if these clouds increase from the west or northwest, a front may soon be approaching with strengthening general winds. Check the fire weather forecast.

Altostratus (several varieties): Mid to high level stratus clouds that are a good indicator of an approaching front with strengthening general winds. Check the fire weather forecast.

Wave cloud or Lenticular cloud: Smooth almond-shaped clouds that sometimes form over mountainous terrain in patterns similar to stacked dishes. These clouds tend to remain fixed over one peak and are a good indicator of strong general winds in the upper atmosphere that may descend to the surface. Wave clouds are sometimes seen during foehn wind events. Check the fire weather forecast.