

THE ATMOSPHERIC RESERVOIR

Examining the Atmosphere and Atmospheric Resource Management

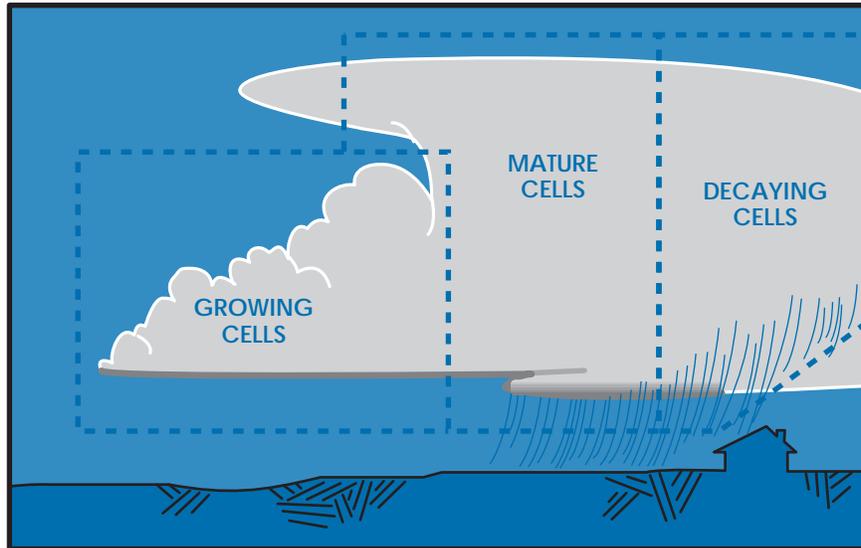
Thunderstorm lifecycles

by Bruce Boe

Three ingredients are needed for thunderstorms: moisture, an unstable atmosphere, and a trigger—something to set them off. The moisture must be present in the form of invisible (uncondensed) water vapor in the low levels of the atmosphere. An unstable atmosphere is characterized by warm air near the surface and much colder air aloft. The temperature contrast is important, for warm air rising from the surface, like a hot air balloon, will continue to rise only if the surrounding air is cooler. The trigger that sets the storms off can be a warm or cold front, or even an “upper level disturbance” associated with the jet stream thousands of feet above the surface.

Thunderstorms, or cumulonimbus, are made up of a number of cloud “cells,” in a variety of stages of development.

Cells in the first stage are all growing and range in size from small pillow-like towers with bright white, cauliflower-like tops, to giant columns up to ten miles high. The tall, cold tops of the latter are often shrouded in less-distinct clouds of ice crystals, giving them a fuzzy appearance. There is no precipitation from cells in this stage. Nevertheless,



The three stages of thunderstorm evolution can often be seen in a single thunderstorm complex.

thunder may be heard. Rising currents of air within the cloud, called *updrafts*, carry additional water vapor into the cloud base where it condenses, building the cloud.

The second stage in thunderstorm cell evolution is the *mature stage*. At this stage, some particles, mostly ice high in the cloud, have grown large enough to begin to fall. This region of descending air and precipitation is called a *downdraft*. Precipitation can be seen where the downdraft emerges from the previously-flat cloud base. Though cells in the mature stage still contain updrafts, they are weakening. Lightning may be frequent and should always be considered dangerous.

The final stage in the life of a thunderstorm cell is the *decaying stage*. At this point, there is no longer any updraft, and the precipitation formed aloft falls from the

cloud. Most thunderstorms produce at least some small hail far aloft, but because the air below the thunderstorm is relatively warm, most reaches the surface as rain rather than hail. Large ice particles such as hail may not melt completely—in which case hail is observed at the ground.

What we think of as a thunderstorm is usually a collection of cells in each of the three stages. If we look carefully, we can see the crisp outlines of the growing towers, precipitation beginning to fall from the flat cloud bases of mature cells, and the rainy portions of the storm comprised of decaying cells.

In the case of a long-lived storm, new cells develop as fast as mature ones decay. When the rate of new cell growth exceeds the rate of decay, the storm as a whole grows. When few new cells develop, the storm weakens. While each thunderstorm cell lasts only on the order of 30 minutes or so, a thunderstorm complex may last many hours, or in some cases, all night! ■

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