Klas Juter

When dark clouds are headed your way, get the crew ready to deal with rain and windy conditions

BY BAYLOR FOX-KEMPER

The power of convection

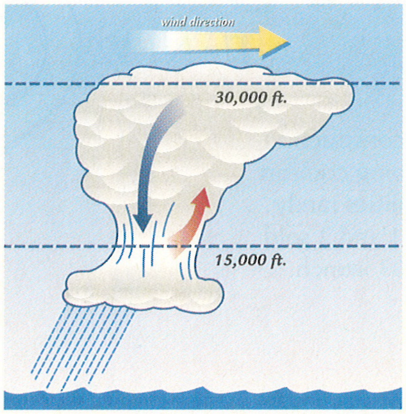
Convection, the up-and-down motion of air within a thunderstorm cloud, is the by-product of an unstable atmosphere with warm, moist air underneath cooler, dryer air. In stable atmospheric conditions a rising air pocket will be denser than the air at its new altitude and will therefore sink back down rather than continuing to rise. When the atmosphere is unstable, a rising air pocket will be less dense than air at the higher altitude. The result is that it rises farther and gains speed as it ascends, like a bubble in boiling water.

These pockets can travel to great heights, and the higher they go the more powerful are the winds formed by their ascent. As the pockets rise they expand and release moisture, creating clouds and rain. Rain often evaporates as it falls, but if the upward convection goes high enough, too much water will be produced for it to evaporate and the rain will reach the ground. If the convection reaches air whose temperature is well below freezing, the moisture that is released can produce hail. Convection height determines how much precipitation and wind will come from a cloud.

Convection will produce a plume-shaped cumulus cloud. If the cumulus clouds you see are short, the rising air is being capped by a stable atmosphere and thunderstorm activity is unlikely. But if the cloud has a lot of vertical height, rain may well result. If cloud height extends up to 15,000 feet and higher with an anvil shape at the top, you know that a thunderstorm has formed (see figure).

The cloud structure will tell you how strong the thunderstorm will be. A thick, dark cloud with sharp edges along the perimeter indicates that internal convection is growing and the storm is gaining strength. A churning plume on top of the anvil or on the top section of cloud that extends to windward is another sign that internal convection is intense. As a thunderstorm ages, convection heights decrease and cloud shape becomes diffuse and fuzzy at the edges.

Convection can get started in a number of ways. Temperature differences between land and sea, or between a warm ocean current passing next to cooler water can heat the air and start the necessary lift that begins thunderstorm activity. An approaching cold front is another classic thunderstorm creator; the cold air pushes up the warm, moist air it is replacing, producing a perfect lifting condition for the formation of multiple thunderstorms, or squall lines, that form along the cold front.



There is strong convection in a churning anvil-shaped cloud that is tall and thick or is elongated at the top; winds and precipitation could be very strong. Moisture lost when air rises is what forms the cloud and produces precipitation. The rising air is replaced by air that is drawn both from within the cloud and from the surrounding air

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A single thunderstorm is usually weaker than a squall line because the precipitation in a single thunderstorm interferes with its convection. But adjacent storms in a squall line can interact with each other, and this can make rising air less apt to be slowed by precipitation. Because convection is more efficient, the storms are more powerful. A squall line can be seen easily and can also be detected by radar. The most powerful storms in a squall line will have the thickest and tallest clouds and will be the most reflective on the screen. Be especially wary of a single storm cloud out ahead of the main squall line; it could contain the highest winds and most rain of any of the clouds and may even be a supercell thunderstorm (see Weather and Sea, June).

Large cold fronts get plenty of coverage in weather reports, but smaller fronts can be large enough to create the necessary lift conditions to start convection. If you re out sailing and a squall line is approaching, plan to drop all sail or to reduce sail as much as possible. If you can t avoid the squalls, head for the section of the squall line that has the most-diffuse clouds. If you re looking at a radar screen, head for the area that is least reflective. That s where wind and precipitation will be the mildest.

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