

## Guidelines for evaluating lightning risk for GLORIA Great Basin field work

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Read the latest National Weather Service (NWS) forecasts for the field-work location and the Forecast Discussion. Watch the sky carefully for signs of cloud and storm development. The big picture portrayed in the NWS forecasts, together with your observations of what is happening locally, give you the best idea of what to expect and respond to in the field. Lightning might strike from a small weak storm, or a person might be unscathed while standing on a hilltop in a powerful storm (not a good idea though)...precise prediction of a strike is not possible. But you can greatly improve the probability of escaping harm by using all of the information you have. As you make the decision to remain or retreat, you are making a decision that will affect the entire field team, and don't lean toward a risk level that might suit just you as an individual.



### Note the forecast probability for "Showers" or "Thunderstorms"

Explicit predictions of thunderstorms are usually given as a probability-of-precipitation (POP, chance that a given point in the area will receive at least 0.01" of precipitation), either numerically or by adjective: PoP **10-20% Slight Chance, Isolated, Widely Scattered, or Few**; **30-50% Scattered or Chance**; **60-70% Numerous or Likely**; **80-100% Thunderstorms or Showers (no adjective)**.

Even a low probability (indicated for example by 10% to 20%, or Slight Chance) can result in a significant thunderstorm someplace. Wherever a thunderstorm occurs, even though most of the forecast area might be unaffected, it can produce lightning, rain, hail, and outflow winds. In general, a higher probability of thunderstorms means a greater chance you'll be affected, more rain and lightning, and also somewhat earlier, than for a low probability.

### Read the Forecast Discussion

The Forecast Discussion, written by the meteorologist and variable in content, can give a more complete picture of where and when thunderstorms could develop, how they will move, and how strong they will be. Over time you can learn what parameters and values are associated with thunderstorm risk.

- The strength and direction of the wind aloft can describe which way storms will be moving and how fast. Storms that move slowly can expose you to more lightning and precipitation. Storms that move quickly might drift downwind off of the high peaks and ridges and shorten your exposure to lightning and precipitation, or if upwind of you might drift your way faster than expected. Storms that tend to follow your planned escape route could erode the effective time you have for escape.
- The "CAPE" (**C**onvective **A**vailable **P**otential **E**nergy, energy gained by a buoyant, rising parcel of air) is a good indicator of the power or vigor of potential storms. A higher CAPE means stronger updrafts, leading to heavier precipitation, and more lightning. CAPE values of several 100s of joules/kilogram are typical of smaller less powerful thunderstorms. Values in the high-100s j/kg to over 1000 j/kg indicate the possibility of vigorous, powerful storms. One form of CAPE ("DCAPE") is also used to indicate the strength of downdrafts and outflow winds, and the forecaster will often comment on that.
- Further comments. Mention of "nocturnal thunderstorms" or "...continuing after dark", etc. indicates the potential for storms not dying down by evening, and continuing into the night. Other measures in the Forecast Discussion include total precipitable water (TPW or PWAT), more is better. A wetter air mass suggests greater potential for showers and instability. It varies with region, but PWAT of a half inch or less means not a lot of water for showers, while an inch or more indicates good shower potential. Another factor in thunderstorm development is the "wind shear" (change in wind speed and/or direction with height). The forecaster will usually describe how such measures will influence thunderstorms, rain, and outflow winds.

Thinking about PoP as an indicator of how likely a thunderstorm is to be near you, and CAPE as an indicator of storm strength, give you a good sense of the potential thunderstorm danger as you start your day. Beyond that, your observations will tell the local story.

### Observe clouds carefully

If there is some chance for a thunderstorm in the field area, you should make a plan that assumes a thunderstorm could develop there. Then watch the sky carefully for cloud development. As long as no big cumulus clouds (Cu) develop you should be fine. "Big" Cu clouds means those roughly like your fist at arms length, or approximately the same depth (top to bottom) as the mountains are high, vs. small, midlevel altocumulus clouds you could cover with your thumb held out.

Rising cumulus columns, or "towers" that are becoming taller than they are wide, with sharp outlines on their rounded tops indicates vigorous convection and growth potential. Cu clouds (being a cluster of several columns) that are massive, with dark bases, and depths of 1,000s of feet are well along to being mature cumulonimbus (Cb) clouds (Figure to right). With such cloud growth you could have less than about a half hour to leave the area and reach a vehicle or closed structure before lightning might occur. When upper portions of deep Cu/Cb clouds are showing fuzzy, diffuse outlines, meaning ice is forming there, you could have much less time, just minutes.

Note the direction clouds move, indicating the direction of winds aloft, and which way storms will likely go. Typically, a mature thunderstorm moves generally in the direction in which the anvil on top points, streaming downwind.

Thunder within 30 seconds of lightning means the strike was within about 6 miles, and NWS says lightning activity is close enough to be dangerous. Notice the time delays and decide if the lightning is getting closer or receding.



*Cb cloud almost fully mature*

### Plan to minimize exposure to thunderstorms, and for adequate time to reach safety

Work in the field areas that put you farthest from safe haven (vehicles or closed structures) when thunderstorms are not predicted. When there is a chance of thunderstorms, try to get the field work started earlier, and done by early afternoon. There may be some days with early, extensive thunderstorms when field work is just not safe.

### Shelter and Exposure

Safe shelter is a closed, metal-roofed vehicle or an intact closed shelter. If they receive a strike the current will flow harmlessly to ground over the surface of the vehicle/structure. Tents and open structures are not safe. Being lower, or less upright, can reduce your chance of a direct strike, but only by roughly a few-fold factor. Only 3% to 5% of lightning deaths and injuries are by direct impact, so being "less prominent" will only reduce risk in the small category of "direct impact". Most of the casualties come from indirect, but harmful, effects such as side-flash, ground currents, conductor contact, upward leaders, and exploding fragments. It is not safe under a tree. The tree may receive the direct strike, but any of the indirect effects is more likely under the struck tree...more lightning deaths and injuries (about 10%) occur to those near trees than by direct strikes (Figure below).



*Cattle under a tree, killed by ground currents.*