

Flying Around Thunderstorms

by K. Truemper

Flying to Oshkosh this year with my friend A. Tamir, we stopped in the early afternoon at Cassville, MO, due to deteriorating weather that spawned thunderstorms. Another plane landed shortly after us. The pilot told us he was coming from Oshkosh, had flown in parts of Missouri at 200 ft AGL, and was planning to go on to Texas. Indeed, he added some oil to the engine and proceeded to take off into deteriorating weather. Maybe he was lucky and did make it home that day. But one would not call his decisions prudent or safe. How can we deal with thunderstorms safely? It depends on the circumstances.

A Model for Thunderstorms

Imagine a pot of water that is being heated on a stove and is close to the boiling point. Now and then a bubble of steam forms at the bottom of the pot, rises, and breaks up as it reaches the surface of the water. Keep that picture in mind when analyzing thunderstorms. The hot water represents hot, muggy air, and each rising bubble corresponds to the rising column of air inside a thunderstorm cell.

When the water in the pot reaches the boiling point, suddenly bubbles rise everywhere. In the corresponding situation, a megasystem of thunderstorms is produced within minutes. On radar, a large area turns yellow (= heavy rain, turbulence), while the rest is green (= rain). Never, ever fly in such weather because it is almost impossible to survive the accompanying windshear of microbursts, the deluge of rain, the lightning, and the possibly occurring hail. Warning signals for this setting are high temperatures, close to 100% humidity, and very strong surface winds. I have seen that setting turn into a cauldron of thunderstorms within 15 minutes, with 40 kt surface winds changing direction by 180 degrees in 20 seconds as a microburst came down on the airport. At that time, I was a low-time pilot, and by sheer luck had landed 10 minutes earlier, learning the lesson while on the ground.

A more benign setting involves well-defined fronts whose movement is controlled by high/low pressure systems. Such a front may continuously change shape, spawn thunderstorms, rain, and even hail. But the movement is predictable, and the cells start, grow, and eventually dissipate in a time frame that allows evasive maneuvers. DTN, now available at most airports, is the best tool for analyzing such weather. You can get the same information at home by going to the AOPA website.

Making Good Decisions

An experienced pilot once told me that he never flies IFR in such a situation since he may inadvertently blunder into a cell, not having radar or a Stormscope on board. So, VFR is advisable even if you are IFR rated. Unless, of course, you have appropriate detection equipment on board. So, let us assume that you plan to fly VFR, as most of us must anyway.

When you contact a Flight Service Station (FSS) while on the ground, the briefer usually paints a gloomy picture that makes flight look like a life-threatening undertaking. The reason for that gloom is liability. No plane has ever crashed when the pilot chose to stay on the ground. So it is up to you to decide which part of the weather is reasonably benign and which is potentially dangerous. This decision may be difficult. It becomes easier if you look at the DTN radar picture while talking with the briefer. Suppose you decide to go. You have one or more of the following problems to contend with: low ceilings, rain with low visibility, hail, turbulence, and lightning.

Low Ceilings

Flying while ceilings come down more and more until you are squeezed at 200 AGL between ceiling and ground is a very bad decision. You must have criteria that absolutely rule out that terrifying scenario. The criteria must be based on two considerations: the altitude rules for VFR and the uncertainties of weather. Let us look at these two aspects.

A veritable maze of VFR regulations concerns flight over densely populated areas, near clouds, and into various classes of air space. One could work out the altitude restrictions for each of the numerous cases. A bit more stringent but workable for flight with reduced ceilings are the following three altitude rules, which assume that flight is below 10,000 ft MSL.

Three Altitude Rules

1. Never take off with a ceiling of less than 2000 ft.
2. During flight, if the ceiling becomes 2000 ft or less, fly 500 ft below the ceiling.
3. Land before the ceiling goes below 1500 ft.

Suppose the ceiling is 2000 ft. By rule #2, you should fly at 1500 ft AGL. That altitude places you below the tops of a number of towers, so careful planning of the route and precise navigation are needed. Suppose the ceiling goes down to 1500 ft. By rule #2, you are at 1000 ft AGL and can land at any controlled or uncontrolled airport, assuming that visibility is at least 3 miles; we discuss the visibility aspect in detail in a moment.

Here is an example how easily you can get stuck if you do not observe rule #3. Suppose the ceiling is 1300 ft and going down, and the closest airport is uncontrolled and in a densely populated area. A magenta area with 10 mile radius encloses the airport. You cannot legally land at that airport for the following reasons. (1) The magenta area means that above 700 ft AGL, you must be at least 500 feet below the ceiling. Thus you cannot be above 800 ft AGL when in that area. (2) The densely populated area means that you must be at least 1000 ft AGL unless landing. You cannot claim a 10 mile final to overcome condition (2), so the airport cannot be used.

Uncertainties of Weather

To account for the vagaries of weather, select the route so that airports occur in close spacing, one after another, even if this means detours. Let me call such flying from one potential landing site to the next one “airport hopping.”

As you hop from one airport to the next, look up the data for that next airport and record them on your pad. Monitor ATIS, ASOS, and AWOS frequencies so that you can update the altimeter and are aware of surface winds. Then, if you must land, you can do so quickly and safely.

Continuously monitor the ceiling ahead of you and behind you so that you become aware of potential problems before they become serious. Return to the most recently passed airport or go to the next one before the ceiling goes below 1500 ft and you get squeezed between a low ceiling and the ground. Do not try to avoid low ceilings in front of you by turning left or right from your course. When such maneuvers become necessary, it is time to turn back and land as soon as possible. Indeed, any detour likely traps you by a low ceiling with no airport nearby.

Rain

VFR requires visibility of 3 miles or better if you adhere to the rules above about ceilings. This means that VFR in rain is possible only if the rain is light to moderate. There is another reason for accepting nothing more than moderate rain. In heavy rain you may blunder into a cell, at which point survival is questionable. So, never ever allow rain to reduce visibility below 3 miles. If necessary, detour around areas of heavy rain. But do this only if the ceiling is not marginal, since otherwise you may get trapped by a low ceiling while evading heavy rain.

Hail

While rain hitting the thin skin of the airplane may sound like hail, do not worry. If it is hail, you will know the difference. Seriously, you avoid hail by staying at least 15-20 miles away from cells.

Turbulence

Watch out for clouds with hanging curtains that do not reach the ground. This is rain that evaporates in the air and is called virga. That setting guarantees moderate to heavy turbulence, so you must stay away. The same applies to turbulence spawned by cells.

Thunderstorm Cells

If cells are isolated and not hidden by other clouds, you just fly around them, keeping a respectful distance of 15-20 miles. This situation occurs often in the Southwest and West. But elsewhere, cells often are surrounded by clouds, and ceilings are less than 5000 ft and often 2000-3000 ft. In that case, stay below all clouds and clear of any heavy rain.

The warning sign of a cell is a dark mass of rain that extends from the lowest cloud layer to the ground, thus obscuring the horizon. That dark mass may only be rain, but you cannot tell. So always assume that it contains a cell.

If there is just one such dark mass, maneuver around it, keeping a 15-20 mile distance if possible, but certainly no less than 10 miles, to avoid the possibly severe turbulence associated with that dark mass. Cells typically move at no more than 40 kts, and often at much slower speed. But when entering the mature stage, a cell may suddenly expand at a huge speed and be on top of you. At that time, you cannot outrun the cell. This is another reason for the recommended distance of 15-20 miles. A third reason is that sometimes a cell pitches hail from the top that may come down several miles away.

Contact with FSS

The discussion so far has centered on your decisions. But while you fly along and evaluate the situation, you should be in frequent contact with FSS to get updates and advice. Such contact is vitally important when several dark masses, and thus potentially several cells, show up. You should not try to select a route without FSS assistance, since you may get trapped with cells in all four quadrants and no airport in sight.

Contacting FSS while flying low is often difficult. At least I thought so until recently. First, Flight Watch 122.0 is the preferred frequency. But unless you are near an outlet, you get no response when flying at or below 3000 ft AGL. Second, most VORs no longer carry voice, and the VOR boxes on the sectional often do not list other voice frequencies. Thus, a near VOR may not be of help either. So how do you contact FSS? Recently, I realized that I should use the AOPA Airport Directory to look up the data for the airport closest to my position. The data include a FSS frequency that normally is used to open and close flight plans. That frequency often is not listed on the sectional. But it is almost guaranteed to work, even when you fly 2000 ft AGL. The briefer may refer you to Flight Watch 122.0, but when you explain that you have not been able to establish contact, you will get help. Give the briefer your present position using the nearest VOR (radial and distance – the GPS radio has this information readily available) as well as altitude and direction of flight. The briefer will explain what you are facing. Do not hesitate to ask for clarification. For example, asking “Will I avoid all cells if I go north for 30 miles and then turn west?” is a good way to clarify whether you have fully understood the situation laid out by the briefer.

Psychological Component

Up to this point, we have covered technical aspects. But there is also an important psychological component that we should take into account. Part of that component is our innate determination to reach goals that we have set for ourselves. Here, it means that we pressure ourselves to reach the destination planned for the day. This pressure, if not controlled, can lead to continued flight into worsening weather, and we may go way beyond

the limits that we set initially for ourselves and end up flying VFR into IMC (instrument meteorological conditions).

How can we counteract that urge to continue when we should stop? There are two remedies. The first one says that we should stick to the following two rules.

Two Rules for Flight Planning

1. Depart as early in the morning as is permitted for daytime VFR, which is up to 30 min prior to sunrise. For me, it is too dark at that time, and I favor 15 min prior to sunrise. In the summer, this means a takeoff before 6 am.

2. Select a destination for the day that can be reached by 1 pm at the latest, assuming that the weather fully cooperates.

If the takeoff is at 6 am, rule #2 allows for a travel time of 7 hours, which translates to two 3 hr legs and a 1 hr break for refueling and relaxing. Suppose the weather deteriorates at, say, 11 am. At that time, we are 1 hour into the second leg, and there are 2 hours left to fly. We tell ourselves “There is plenty of time left in the day to do 2 hours of flying, so let’s take it easy and not press forward,” and thus remove the internal pressure to go on.

On the other hand, if the weather cooperates till we have completed the second leg, we can optionally extend our schedule. If the weather deteriorates during that optional third leg, we tell ourselves “We have already achieved more than we had planned, so let’s stop and enjoy the rest of the day on the ground.”

The second remedy I learned from Don Christianson. As the weather becomes more and more ominous and we feel the urge to continue the flight, we tell ourselves repeatedly “Is this really the day I want to die?” Once we have repeated this question a few times like a mantra, our brain becomes aware that there is more to life than pressing on to the planned destination, and it begins to make sensible decisions like landing at the closest airport.

Belief in Persistence of Present Conditions

There is a second psychological aspect that works against us. It is our belief that things will continue to be the way they are now. As we see poor but acceptable weather around us, we tend to believe that it will persist that way for miles ahead. But if anything is not constant, it is weather. If the weather is bad, we should not tell ourselves “This is not great, but good enough to continue.” Instead, we should say “This is bad, let’s be cautious and make sure we do not get trapped if it deteriorates.” A short version that can be used as a mantra, is “This is bad weather; we must be very careful.”

The belief in persistence of the present situation has another undesirable effect. Once we have landed due to bad weather, we may believe that bad weather will continue for the rest of the day and check into a motel right then and there. If we departed at 6 am as suggested, the landing due to bad weather takes place in the morning or at most around

noon, and there is lots of time left for the weather to improve. I have found a number of times that dismal weather often improves around 4 to 5 pm and stays fair at least into the early evening. So, if we take off at 5 pm, we may well have another 2-3 hours of flying time left, which usually suffices to reach the planned destination.

The rules for coping with the psychological component are then as follows.

Rules for Handling Psychological Component

1. Leave as early as daytime VFR allows.
2. Select a destination that under normal circumstances can be reached by 1 pm.
3. Two mantras for deteriorating weather: “This is bad weather; we must be very careful” and “Is this really the day I want to die?”

If you follow the above rules, you can fly safely in difficult weather. On our Oshkosh trip, we used these rules extensively. Except for one day when we were weathered in Osage Beach, MO, we reached each destination as planned and without compromising safety. While at Oshkosh, we learned that 13 people had died flying to or from Oshkosh. Given the bad weather prevailing in the Midwest and elsewhere during that time, I suspect that weather was at least partially a factor in many of these fatal accidents. We can do much, much better, by using good decision procedures and safe practices.