Pre-Flight

COPA Corner: Flight Through Thunderstorms is Asking for Trouble

by Donald Anders Talleur. This article was originally published in the October 2010 issue of COPA Flight *under the "Pilot's Primer" column.*

I write this article shortly after Flight 8520, an AIRES Boeing 737, crashed while on approach to San Andres Island, a Colombian resort area. While the investigation of this crash is still ongoing[1], I feel compelled to focus on one prominent circumstance that could have played a role in bringing this aircraft to the ground prematurely.

According to all reports, Flight 8520 was flying through a thunderstorm during the approach to landing. While I do not intend to speculate on the particulars of this crash, its occurrence is a reminder that there are inherent dangers in attempting to fly through a thunderstorm, and it is those dangers that I'd like to address this month.

Thunderstorms contain some of the scariest weather known to man, and the danger of that weather is well known.

Wind shear, microbursts, hail, lightning and turbulence are the main hazards and exist in thunderstorms to varying degrees depending on the size and strength of the storm. I should point out that size and strength are generally synonymous in that a storm with very high tops is also generally capable of producing the worst weather.

Although wind shear and microbursts can occur independently of a thunderstorm, as "painted" on the radar, those associated with a thunderstorm frequently produce the most hazardous flight conditions.

There are a slew of accident cases that list wind shear/probable microburst as contributing to the ensuing loss of control. The typical situation is that an airplane gets into a wind shear situation close to the ground during approach to landing. A sudden shift in headwind component means a loss of indicated airspeed.

On final approach, the margin between indicated and minimum safe flying speed is small, so any sudden loss of airspeed often signals the need for immediate action on the pilot's part. Failure to react quickly can result in a stall or even premature ground contact. Typically, wind shear close to the ground does not exceed 20 kt, so it can usually be "powered" out of. That being said, if a report for wind shear exists, extreme caution should be taken when attempting a landing in such conditions.

If wind shear is encountered during landing or takeoff, the airspeed loss or gain and the altitude of occurrence should be reported to ATC.

While wind shear is relatively common, a less common type of wind shear event is the microburst. If there can be a worst-case wind shear scenario, I'd have to say that a microburst is it. Years ago, I saw what a microburst could do when one hit a small airport northwest of the Chicago, Ill. area.

The damage was amazing. If it hadn't been classified as a microburst, I might have suspected a mini-tornado. Tied down airplanes were uprooted, and one was even found upside down on top of a nearby hangar. A nearby barn was flattened. Now picture yourself trying to fly through something that could do all of that!

Several airliners have tried over the years and failed miserably. An L-1011 crash at Dallas/Fort Worth a bunch of years ago was tragic testimony that a microburst can bring down the largest of aircraft.

Since then, some pretty smart folks in the U.S. have looked into the microburst phenomenon and made startling findings. They found that microbursts are a whole lot more common than anyone had previously thought.

1 The final occurrence report into the AIRES Flight 8520 accident has been released by Colombian authorities since the original publication of this article. The probable cause of the accident was: "Execution of the flight below the angle of approach, due to a misjudgment of the crew, believing to be much higher, leading the aircraft to fly a typical trajectory of a 'black hole' illusion, which was experienced during the night-time approach to a runway with low contrast surrounded in bright focused lights, aggravated by bad weather of heavy rain." (from the Aviation Safety Network's Web page on Flight 8520)

Through the use of sophisticated measuring equipment they mapped out microburst activity at and near major airports across the U.S. and came to the conclusion that microbursts are possible anywhere there is convective activity (i.e. thunderstorms).

Although many microbursts were of an intensity that a large airplane might make it through, many more were of an intensity greater than what brought down that L-1011. While I won't go into the gory details of how a microburst works in this article, it's clear that the name of the game is to avoid microbursts in the first place. The best way to do that is to stay away from thunderstorms.

Another hazardous feature of thunderstorms is turbulence. Although generally brief, turbulence in a thunderstorm can be quite violent. The combination of updrafts, downdrafts, swirling and shifting patterns of air within a thunderstorm can lead to turbulence that is too difficult for even a jetliner to traverse.

Case in point, just today there was news of a jetliner on the east coast of the U.S. that diverted for landing after encountering severe turbulence in or near a thunderstorm. This is exactly the type of weather event that should be avoided if possible.

However, the major difficulty in avoiding turbulence is due to the difficulty of accurately predicting its whereabouts. Luckily, with the advent of Doppler radar, air currents likely to produce turbulent conditions are more easily identifiable. Still, air current activity in a thunderstorm changes frequently, making precise predictions impossible.

As a result of the somewhat stealthy nature of turbulence, as a general rule, expect it anywhere near or within a thunderstorm.

One inevitability is where there's a thunderstorm, there's lightning. This point is academic since to have thunder there must be a preceding bolt of lightning. Lightning is rarely accused of bringing down airplanes these days (although it has happened and will probably happen in the future) owing to advances in the bonding of aircraft structures to facilitate the better distribution of the charge and subsequent discharge back into the air. At worst, airliners generally suffer nonstructural issues such as nose cone or wing tip damage, but there have been a few suspected cases where a strike led to a fuel tank rupture and tragic results.

Newer aircraft with composite structures present new problems in that a strike can lead to delamination of material near the strike zone as well as the conventional damage expected at the discharge point(s). Since there is really no way to know how a given aircraft will react to a strike, the best solution is to stay at least 10 mi. clear of thunderstorms. Why so far, you might ask? Simple! Lightning need not stay in the cloud, and if your airplane is a convenient object to attract the strike, then… tag—you're it!

One last serious hazard, as if the others weren't bad enough already, is hail. Imagine your friend throwing ice cubes at you from a distance of 10 ft. It probably won't kill you, but if he throws them hard enough, expect some small bruises. Now imagine him throwing those cubes at you at 200 kt. Ouch!

A jetliner flying through hail won't "feel" much better, and the Internet is full of interesting pictures of damage caused by relatively short encounters with hail. Busted or completely shredded nose cones, busted windshields, leading edge damage that will make you think the airplane flew through a baseball factory; these are serious problems to be sure.

The damage to a small airplane can be equally as bad even though the speed is usually much lower. Slower aircraft will be slower to exit the hail and that means more time for damage.

So how does a pilot avoid hail? Well, for starters, never fly under anything that looks like the anvil of a thunderstorm, and also don't fly through the vertical thunderstorm cloud. Although hail falls in relatively predictable areas of a storm, a pilot does not generally have the information available during flight to select the right path. Also, although you might fly in the clear air below an anvil, it may be difficult or impossible to spot hail falling prior to running into it.

If I've scared you enough to keep you out of thunderstorms then I'd say this article has been a success. These weather phenomena are serious hazards to all aircraft and should be avoided at all costs. Don't believe that just because someone you know made it through a storm, that it's possible to do so on a regular basis.

The only way an airplane makes it through a full-blown thunderstorm unscathed is by luck. Don't get me wrong, luck is good, but if you're not the type to gamble your entire life savings on a card game, then you might just want to wait out that thunderstorm. The odds of winning the card game are probably better than winning a bout with a thunderstorm. △

This month's Pilot Primer is written by Donald Anders Talleur, an Assistant Chief Flight Instructor at the University of Illinois, Institute of Aviation. He holds a joint appointment with the Professional Pilot Division and Human Factors Division. He has been flying since 1984 and, in addition to flight instructing since 1990, has worked on numerous research contracts for the FAA, Air Force, Navy, NASA and Army. He has authored or co-authored over 200 aviation-related papers and articles and has an M.S. degree in Engineering Psychology, specializing in Aviation Human Factors.