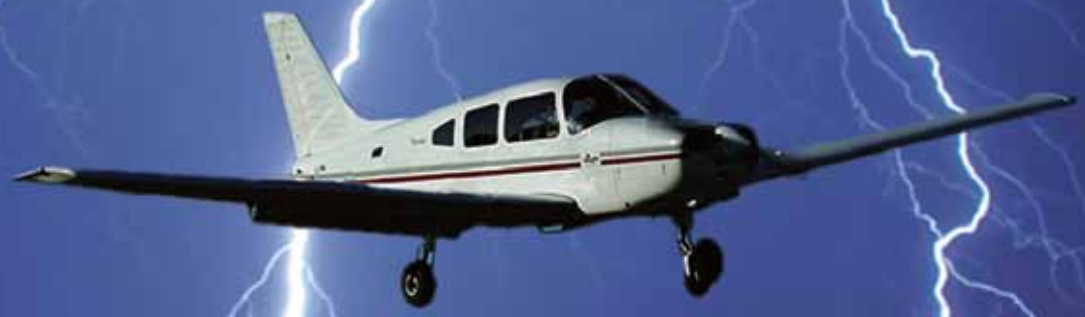
Avoiding the Bullies

Lightning & Turbulence



STORY BY DAVE HIGDON

Fly enough hours and chances grow for a pilot to face weather conditions preferably avoided. Pilots often fly circuitous deviations off the most direct route just to avoid such encounters. Think of a child taking the long way home to avoid class bullies.

Bullies wait ahead, and straight ahead is the short way home. One choice offers greater safety at the expense of time and distance; the shorter way invites a licking.

In aviation, the bullies are the conjoined twins: lightning and turbulence. Only one other weather condition matches the potential danger of a storm encounter: icing.

A more subtle, silent threat, airframe icing morphs and degrades airfoil performance and quickly adds weight. Conversely, lightning generally is obvious in its malevolence, and turbulent conditions almost always co-exist with electrical displays because, as we're taught, it's turbulence itself that generates static electricity, which lightning releases.

Few aspects of aviating match the discomfort accompanying a full-on encounter with a storm producing these two co-conspirators of lightning and turbulence.

Turbulence doesn't automatically portend lightning; other conditions cause turbulence: the shearing action between layers of air moving in opposite different; mountain-spurred turbulence from high winds; the boundary layer announcing the approach of a front.

While seldom as savage as the turbulence of a lightning-laden thunderstorm, these types of turbulence also justify avoidance because of the discomfort they create.

Degrees of Discomfort

We seldom bat an eye at light turbulence — when the airplane experiences only slightly erratic changes in altitude or attitude. Should conditions progress into light chop, the ongoing arrhythmic bumps it brings might wear on us.

The rapid jolts and noticeable displacement of moderate turbulence should be a wake-up call to make a new decision lest conditions progress to moderate chop with more frequent and pronounced arrhythmic bumps.

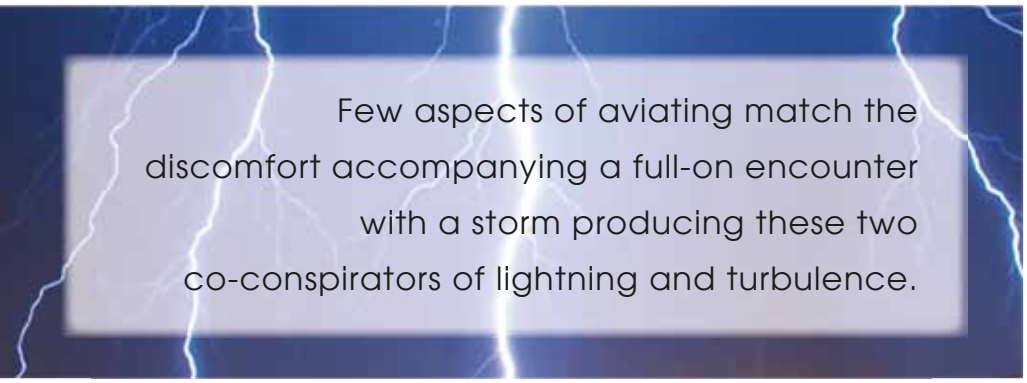
We quickly recognize encountering severe turbulence, with large degrees of displacement and wide swings in airspeed. Touch the edge of extreme turbulence, and the feeling most coveted is the relief of escaping to smooth air.

Continued on following page

Continued from page 29

Typically, those higher levels of turbulence come in the vicinity of a significant storm: Level 3 and above. But pilots can find themselves in the maelstrom with little warning, despite forecasts, even while turning to avoid similar conditions elsewhere.

While we generally see something of lightning's output, we can only infer the location of turbulence, in part because we've learned of the conjoined nature of turbulence-generated lightning. This has made detecting lightning a primary way of avoiding both electric and turbulent encounters.



Risks Abound in Those Bumps

Any encounter with the violence of severe or extreme turbulence instills an appreciation for the chaos of the atmospheric churn. Ignoring its power brings significant risks.

Turbulence is a main cause of injuries on airline flights. The injuries generally result from a sudden, unexpected encounter with conditions that announce themselves by tossing unrestrained humans against the ceiling until gravity resumes control and drops the unfortunates.

The National Transportation Safety Board studied a seven-year period — 2003 through 2009 — and found 80 incidents of turbulence seriously injuring one or more people on the affected airplane.

Earlier this year, airliner captains twice diverted toward treatment for the injuries of passengers tossed about the cabin. In one instance, 30 people on one airliner suffered injuries.

The plane itself faces risks depending on how the pilot handles a rough-weather encounter. Go too fast in too much turbulence and the airplane can break up; go too slow and control becomes more difficult.

Unfortunately, remaining grounded is the only surefire way to avoid turbulence.

With its power to damage electrical and electronic components while burning holes in the airframe, lightning sounds scarier than turbulence. The emphasis, however, should be on joint-avoidance efforts, and this is where technology can help your customers.

The symbiotic relationship between turbulence and lightning underpins one of the older, more useful onboard and ground tools for storm avoidance: the spherics device.

Thanks to advances in radar displays, digital processing, Doppler radar and lasers, we are closing in on tools to detect turbulence absent electrical discharges.

A Hazard-Avoidance Hat Trick

Although we seldom tune in AM radio these days, it serves as an omni-directional lightning detector, picking up the burst of radio-frequency energy that occurs with lightning strikes and "playing" this energy as audible bursts of static.

Building on the phenomenon, the avionics industry offers pilots several systems capable of detecting both the soft, aerially discharged pulses of airborne turbulence and lightning.

A spherics device works on the same principal: Listen for the same radio-frequency emissions of lightning strikes that produce static on AM radio.

Because of the sensitivity of these systems, they serve as much as a tool for avoiding turbulence — the harbinger of static-electrical buildup — as for the lightning itself.

A spherics device uses a sensitive directional antenna to generate a bearing to the radio frequency; signal processing of the lightning signal to calculate distance; and convert it into a display indication. The spherics hardware available for aircraft offers sensitivities, accuracy levels and features that make them specifically attractive as one of the triumvirate of weather-avoidance technologies.

The two other technologies — radar and data-link — provide their own benefits, complementing the spherics device in cockpit functionality.

Airborne Radar, Cockpit Data-Link

While the spherics device shows the location of air with turbulence strong enough to generate electrical discharges even outside a storm environment, a spherics device is best complemented with at least one other avoidance tool: in-cockpit weather data-link or onboard color weather radar.

Research has produced computer algorithms allowing some airborne radar equipment to detect and display the rapid, sometimes violently moving atmospheric bands that produce turbulence — in addition to better depiction of rainfall intensity.

Modern Doppler radar adds depth to the capability of onboard color weather radar with color-coding for turbulent conditions that differentiates it from rainfall levels. While today's color Doppler radar systems vastly improve on the detection of rain and painting the variations in rainfall within a storm, they are limited to seeing out a couple hundred miles.

Both radar and lasers have been tested as technologies to detect turbulence in clear conditions, but primarily for transport-category and larger business aircraft, and only within a few miles of the aircraft.

Data-link services offer another direction general aviation pilots can take. Like radar and spherics, data-link requires equipment to receive and display the weather products, plus a delivery service subscription. The wealth of information available can greatly improve a pilot's situational awareness — and do so for the entire Lower 48 states, providing the pilot with a view hundreds of miles out and in all directions.

Many pilots consider the data-link option a perfect complement to the onboard spherics device — even when they have access to airborne weather radar.

Among the data-link products pilots most covet is an old, familiar friend from TV weather shows: Nexrad, or next-generation Doppler radar.

The Nexrad weather radar images employed in data-link services show severity of precipitation and turbulent air in the color magenta, thanks

Continued on following page

Advertisers Index

WEATHER AVOIDANCE

Continued from page 31

to the system's ability to detect direction and velocity of water in the atmosphere. Couple this information with the instant display of lightning strikes and long-range lightning information from the data-link provider, and you get a broad picture of where not to go.

There's also value in the other products delivered via data-link.

Active Avoidance: Tool Options

Weather radar is all but non-existent for the majority of light general aviation aircraft, with only a few exceptions.

Data-link and spherics, however, are adapted easily to even the most modest aircraft. WxWorx, XM, WSI, Sirius and WingMan are some of the sources for data-link weather service.

Beyond the Nexrad Doppler radar images all of them provide, pilots also value lightning-strike information, winds aloft, freezing levels, cloud levels, precipitation intensities and much more. It's like plugging into the Flight Service Station weather display, with information updated every few minutes.

The FAA promises similar services as part of its ADS-B service through the Flight Information Service-Broadcast, or FIS-B. Getting FIS-B requires adding ADS-B In equipment.

Going Data-Link: Plenty of Options

Among the wonders of modern avionics, data-link services are available through a wide variety of installed and portable solutions, which all share common elements.

First, data-link needs a color display on which to view delivered data and images. In this area, pilots enjoy the broadest range of options imaginable, from the entire spectrum of panel-mounted multi-function displays to a host of portable devices.

Garmin's 396, 496 and 696 are weather-data-link capable, as is the company's Aera line of portables, which includes models capable of displaying satellite weather.

Displays as small as Honeywell's AV8OR, the larger AV8OR Ace and two AV8OR 3D models all can display WX weather.

Pretty much any panel-mounted MFD also can display satellite or ground-based, data-link weather. Honeywell's new KLN 770 all-in-one nav/com/GPS receiver/MFD also works here, as do Garmin's GNS 430 and GNS 530 all-in ones and many of Avidyne's MFDs.

Beyond the display solution employed, the pilot needs two other items a dealer or shop can help with: a data-link receiver specific to the delivery-service provider that works with the display of choice; and a subscription to the data-link service — generally priced at about $50 per month.

No data-link-using pilot I know would willingly give up his data-link.

Spherics Devices: More Options than Ever

Labeled by some as the poor-pilot's radar, many general aviation pilots consider a spherics device to be the best weather-

avoidance tool available — outside the Mark II Eyeball.

Going back to the earliest Ryan Stormscopes of decades ago, spherics devices have proven themselves a practical weather-avoidance tool.

Today, dealers offer choices from manufacturers such as L-3 Avionics Systems, the successor maker of the Stormscope line; Insight Avionics with the Strikefinder line; Honeywell with the LSZ-860; and Avidyne with the TWX670, the first color-coded spherics detector.

Avidyne's system offers its own unique features to identify storm cells as opposed to merely identifying lightning-strike points; it requires a panel-mounted display.

The Insight Strikefinder is a stand-alone, self-contained unit that can be gyro-stabilized to maintain correct orientation of recorded strikes displayed as the aircraft maneuvers.

The Honeywell LSZ-860 system is designed more for installation in larger business jets and transport aircraft, with better shielding to protect it from spurious and stray radio-frequency interference — as such, it's the most expensive.

L-3's Stormscope line is the broadest, including self-contained models. The line ranges from the WX-500, a box-only system designed to play on a MFD, to the higher-end WX-1000.

Avionics shops need to ensure aircraft owners understand installing most of these systems requires accurate mapping of radio-frequency sources and interference in the actual aircraft — with placement of antennae in spots with little or no RF interference.

"That mapping can take time," said Tom Harper, director of marketing for Avidyne. "Without taking the proper steps in the installation of the antenna and shielding the connecting cable, the system can pick up and display a lot of false targets."

Aircraft owners also should know learning to use and interpret the strike data can be as important as learning to fly an ILS approach.

Why Pilots Prefer Two?

Radar comes with limitations. Range, depth into a storm and antenna attenuation all cut into its effectiveness as a precipitation detection and avoidance tool.

Data-link is only as accurate as its last update — and the static, single-snapshot picture gets progressively farther out-of-date. Updates, while only six or so minutes apart, can suffer from latency in the system of gathering the national radar mosaic and in downloading the data package.

Spherics devices, while excellent at detecting lightning discharges — and by extension, the turbulent conditions that sparked the static charge — see only a couple hundred miles; data-link sees the entire country. Spherics devices, however, are instantaneous and an accurate reflection of the dynamics of a storm.

Safety instructors and flight instructors alike recommend pilots avail themselves of two tools — or three, if budgets and aircraft allow. For most pilots, one of the two always will be a spherics device. ❑