Weather the Weather

Datalink, sferics and radar for the light aircraft pilot

BY JULIE K. BOATMAN

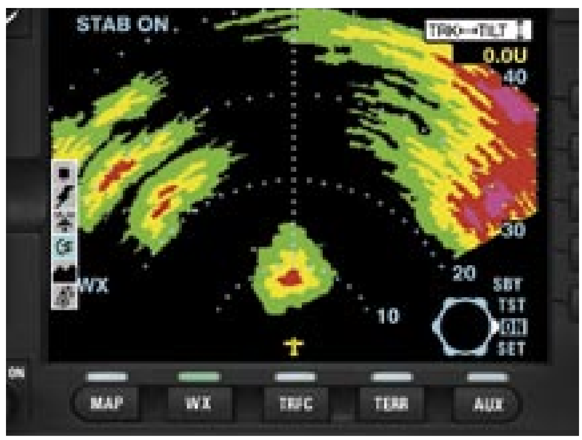
The best forecast is still just a prediction—an educated one, but a prediction nonetheless. We know that the only weather we can count on is the weather we see out the window. And from the windows of our cockpits, what we see isn't always the big picture.

Enter weather products for the cockpit.

Airborne weather radar and sferics (lightning detection) devices have become good friends to us, having been on the scene for decades. Datalink weather products have only recently taken the market by storm. Whether radar, sferics or datalink, each system gives us an additional source of information to traditional outlets of airborne weather data: flight service stations and our own eyes. Taken together, the composite of this information helps us build a more complete picture of what the weather is doing, allowing us to more readily determine what it might do farther along our route of flight.

Airborne Radar

Radar uses electromagnetic waves that bounce back to the airplane's radar antenna when they encounter enough solid precipitation, most likely liquid water, hail or snow. The bigger



the drops, the stronger the echo. When used by airborne radar devices, this echo is measured by the radar receiver and depicted on a screen inside the cockpit, typically in shades of green, yellow and red (light to heavy precipitation). While we don't have the space here to delve into radar in detail, here are some very basic points to consider.

Radar systems vary in usefulness directly with their power output. A strong wave sent by a powerful—large—antenna penetrates any weak precipitation immediately along the airplane's flight path to read heavier areas of precipitation that may lie just beyond and send back these echoes. A weaker wave from a smaller antenna suffers more from attenuation—it may not have the energy to cut through the lighter precipitation to see the heavy precip further down the line. Only the weak echoes in the foreground are visible on the cockpit display.

For example, if you are flying toward a strong cell, a weak radar signal will bounce off the lighter areas of precip at the edge of the cell, masking the cell's core and the serious activity it hides. A stronger signal will bounce some waves off the light precip, but enough energy will continue through the lighter area to bounce off the heavier precip closer to the center of the cell. With the stronger radar, you see both. With the weaker radar, you see only green.

In order to get the most from your airborne weather radar, you must use the system correctly. The unit makes no distinction between returns bounced by water or other solid objects, such as the ground, so you must properly adjust the unit so that the beam is tilted in your direction of flight—and readjust the tilt if you leave cruise for a climb or descent. Also, be wary of shadows—areas where the beam picks up a section of green returns and abruptly shows nothing behind them, with the return forming a bowed shape. These shadows may point to stronger areas of precip that the beam cannot penetrate.

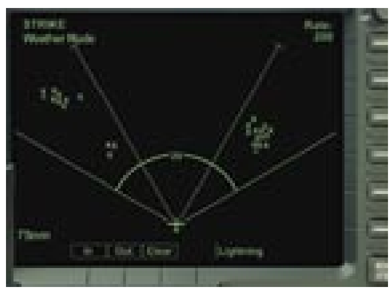
The size of the radar antenna and the unit's power output makes all the difference. There are several systems available with antennas small enough to hang (normally in a wing pod on singles or mounted inside the nose cone on multiengine aircraft) on light airplanes, but because of the relationship between antenna size and utility, you should opt for the largest antenna your airplane can aerodynamically (and aethestically) carry. You also need to budget a good chunk of real estate on your instrument panel for the radar display. Most measure between four to five inches across and three to four inches tall.

If you do a lot of weather flying—and take a course in how to work the radar system well—the addition of radar could give you the extra bit of data you need to safely navigate around thunderstorms. Current manufacturers of airborne weather radar include Collins, Bendix/King and Honeywell.

But radar is only one piece of the puzzle.

Sferics

Sferics also listen for electromagnetic energy, but instead of sending out energy to bounce back, they tune in to the atmosphere's discharges—in the form of lightning strikes. Lightning detection devices use an algorithm to determine by their strength the distance and azimuth of the strikes, and display that position on a screen on the instrument panel.



These devices do a good job of painting thunderstorm cells—with a broad brush. If you see a cluster of strikes grow heavier, it's an instant alert that all is not well in that quadrant of your screen. But, as with all airborne weather products, you need to understand the limitations of the data in order to steer a safe course.

Most devices have a Clear button that removes all strikes from the screen. You can use this tool to determine how quickly the strikes regenerate, which tells you the relative strength and growth of the cell. Also, false ranging can happen when a stronger-than-average cell shows up as a cluster of strikes on the display closer than the storm's actual distance from the airplane. Conversely, a weak cell may be depicted by strikes that are at a farther range than the storm's actual position. If strikes are lined up along your course, this portends a stronger cell beyond the range of the display. And any source of electrical energy (including a poor ground in the airplane itself) can cause false returns.

Lightning detection devices are a good solution for aircraft owners without the panel space and room on the aircraft for a radar antenna. They provide the information that most light aircraft pilots want to know about the clouds ahead: Is a thunderstorm lurking behind that wall of gray or in the midst of that benign-looking cumulus?

With both sferics and radar systems, the price of the initial hardware, plus any required maintenance on that hardware, are the only costs associated with using it. Current manufacturers of lightning detection devices include Insight and L-3.

Datalink weather

Over the past few years, datalink (which is a pipeline for sending digitized information to the cockpit) has been used by various avionics manufacturers to deliver weather data to light GA aircraft. The information provided via datalink is quite different from that available from sferics and

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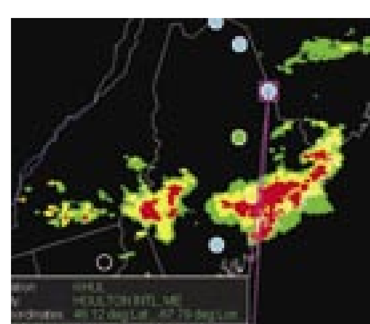

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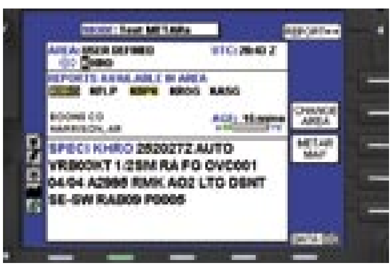
airborne radar—but chances are you're already familiar with much of it, if you've ever watched the Weather Channel or pulled up Metars and TAFs from DUATS.

Datalink comes to the cockpit in essentially two different ways: via satellite or via ground-based stations. Satellite delivery of datalink can be accessed virtually anywhere from the ground up, as long as a satellite in that network is "viewable" by the aircraft antenna. Orbcomm and GlobalStar are the two satellite networks currently in use for weather datalink in the continental United States.



Ground-based stations, meanwhile, are located across the continental United States, and good coverage is available from upwards of 5,000 feet MSL, higher in mountainous areas. Flight Information Services Data Link (FISDL) is one ground-based service sanctioned by the FAA, and it offers basic services (textual Metars, TAFs, airmets, sigmets, and convective sigmets) free of charge if you have the appropriate onboard equipment.

A variety of weather products can be accessed via datalink. While they vary by manufacturer, these products usually include Nexrad weather graphics, textual and/or graphically depicted Metars and TAFs, echo tops or cell information, pilot reports, alert weather watch areas, and airmets, sigmets, and convective sigmets. Each manufacturer takes National Weather Service information, processes it, and checks it for accuracy before molding the data into proprietary graphics and text presentations.

Depending on the manufacturer of the equipment and the service provider, datalink weather is typically delivered either in a continuous stream or through a request/reply process. When datalink downloads in a continuous stream, each product is delivered in a packet on a rotating basis once the datalink software is turned on.

For example, when you start the airplane, and turn on the avionics master, you turn on the hardware—and with it, a datalink receiver of some type, either on the panel, in a portable device, or remotely mounted in the airplane—on which the datalink information is displayed. After the system boots or initializes, the software establishes communication with the satellite and begins pulling in the stream, typically starting with the next complete bundle of data in transit. Once that bundle is fully transmitted—say it's a series of Nexrad radar graphics—that product will be available for display on the box, whether that box is a multifunction display (MFD), combination navigator/MFD, or portable unit (personal digital assistant, laptop, or tablet PC). The stream continues, and the datalink receiver keeps pulling in the next package of data, and once that's transmitted, it's ready for display. When the full range of data is transferred, the process begins again when new data becomes available.

Continuous stream systems do not typically download information any faster than request/reply systems; the information simply downloads in the background from the moment you initialize the system. The continuous stream mode of delivery holds advantages to pilots who fly several cross-country trips a month, and those who fly IFR on a regular basis.

Datalink can also be delivered via request/reply service. With this type of service, you get the weather and particular products you request, at the time of your request. You must query the system for the information several minutes in advance of when you might need it, since the data takes anywhere from 30 seconds to several minutes to download. Newer request/reply systems allow the pilot to select automatic requests, meaning the system will automatically request certain weather products at set intervals—every 20 minutes, for example. This reduces the latency issues for those who must manually request the reports. An advantage of request/reply service is the ability to pay for only the weather you use and with some systems, the ability for the pilot to send and receive other non-weather-related messages in the airplane.

Most datalink display and receiver systems offer a status page for you to view the current transmission and the age of each data package. Also, the age of the data can be shown on the same display page as the data. For example, a six-minute-old Nexrad image might have a “6 min” notation in the corner of the screen. This age is important, and drives home the most salient point regarding datalink weather—radar graphics in particular: The Nexrad mosaics you see on the screen are always several minutes old by the time you view them. As a result, they can only be used for strategic avoidance—not close-in, tactical avoidance. You can see what the weather was a few minutes ago, and alter your course appropriately, but you should never use these radar graphics to penetrate a line of thunderstorms.

Accessing datalink weather products usually involves some form of pay-as-you-go cost in addition to initial hardware and/or receiver acquisition, installation and maintenance costs. You can typically subscribe to a given level of service each month or year, or pay for each unit of information (as described in the section on request/reply service).

Depending on what kind of display you wish to use and the service you prefer, there are several manufacturers and providers of datalink weather information on the market. Providers of service to panel-mount displays include Arnav, Avidyne, Echo Flight, Garmin, Honeywell Bendix/King and WSI. Control Vision, Echo Flight, WSI and Wx Worx provide datalink weather to portable devices. ■