Windshear: Progress but no solution

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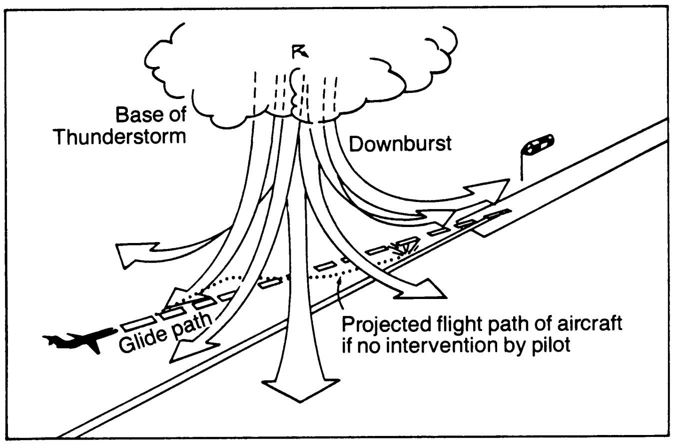

The downdraft spreads out as it approaches the ground. The plane, instead of flying a straight path to landing, first encounters a headwind, which lifts its nose, and then a strong tailwind, which forces the nose down. At low altitudes the pilot sometimes cannot compensate for the wind changes, and the plane crashes.

The problem is far from solved, but researchers are making progress in predicting and dealing with the short-lived wind phenomena called microbursts. These are the small-scale downdrafts that at times have proved disastrous to planes attempting to fly through them. Researchers have analyzed the data collected during the Joint Airport Weather Studies (JAWS) project last summer (SN: 8/21/82, p. 118), and are working closely with the Federal Aviation Administration (FAA) in implementing some recommendations that may alleviate the hazard posed to aircraft.

Microbursts occur because as downdrafts plummet rapidly toward the ground, they spread out horizontally. When a plane encounters one at low altitudes, it may experience a sudden shift in wind direction, or windshear, causing the plane to lose crucial lift on the wing and head into an irreversible dive.

John McCarthy of the National Center for Atmospheric Research in Boulder, Colo., says that according to the JAWS results, the "typical" microburst was about two kilometers across. When first detected its velocity was about 12 meters per second. Within six minutes of the time of first detection, its velocity had increased to about 25 meters per second, or 50 knots. Within 10 minutes, 95 percent of the 75 microbursts observed by radar had reached their maximum intensity.

The fastest speeds observed occurred at about 75 meters above the ground—the same height at which pilots must make their final decision whether to land.

"There's no single solution to the low altitude windshear problem," McCarthy says. "It's training, education, better sensing, and better transmission of information. No single sensor is going to solve the problem, including Doppler radar."

The researchers have concentrated on three of these areas ic their recommendations to the FAA. The Low Level Windshear Alert System, for instance, is in sore need of improvement because its scale is too coarse to allow many microbursts to be detected. The present system has difficulty covering areas less than three km and sometimes less than six km across. McCarthy says that the strongest recommendation is that the FAA proceed on an airport-based Doppler radar program. While not foolproof, the radar can detect microbursts in a more timely manner. "You have about a minute to get the word out at the most, and it has to be a fully automated system," he says.

The researchers also are working to improve windshear data for the flight simulators that are used to train pilots to cope with hazards like microbursts. With the FAA, the Boulder research center also has released a training film to help the pilots appreciate the magnitude of the windshear hazard, and to enable them to recognize clues that they may be encountering a microburst. "We want to instill in pilots the view that whereas there are some techniques that you can use to get through windshear, there are other shears that you can't get through, period," McCarthy says.

Microbursts are a frequent occurrence, but if a plane does not encounter one below 150 meters, it isn't a problem."What may be a fairly common meteorological event is a rare event in terms of encounter," McCarthy says. "The probability of getting grabbed by one is low, but the consequences if you do are high."

—*C. Simon*

Sources sought for Arctic bromine pulses

Unusually high levels of bromine gas and particles detected in Arctic air samples by ground-based instruments have focused scientific attention on this heretofore little-studied trace gas. Measurements from 1976 to 1980 show that during the three-month Arctic spring, vast pulses of bromine enter the atmosphere. During these pulses, scientists report, levels of bromine over the Arctic are at least 10 times those found elsewhere in the world.

The finding is intrinsically interesting because it is so unexpected; its implications for stratospheric chemistry may prove more provocative still. Walter Berg of the National Center for Atmospheric Research in Boulder, Colo., and colleagues describe their study in the August JOURNAL OF GEOPHYSICAL RESEARCH.

Berg says that the springtime increases in pollutant Arctic haze (SN: 1/29/83, p. 69; 4/9/83, p. 229) may contribute some of the bromine, but do not constitute the major source. (In this study "bromine" refers to a group of gases including methyl bromide, bromoform, methylene bromide and ethylene dibromide.) During the dark winter months, there is little rain or snow to cleanse the Arctic air, and no light to drive some of the photochemical reactions that remove pollutants. Thus, gases transported from the world's industrial regions tend to build up. Kenneth Rahn of the University of Rhode Island in Kingston and a co-author of the paper, says that most of the pollutants in the Arctic haze are present roughly in the same proportions as they are in the industrialized areas. The bromine pulses in the Arctic, however, far surpass these proportions.

The researchers are also studying whether the gas may be contributed by marine microorganisms that bloom as the Arctic emerges from its winter cloak of darkness. "We think that's going to loom as the large source, but the data are uncertain," Berg says. There is a circumstantial link, he says, with high levels of bromoform in the open ocean off Greenland and Norway. Recent flights as part of the investigation into Arctic haze show that bromoform is the major form of bromine in the atmosphere. Marine plants and organisms produce far more bromoform than their terrestrial counterparts.

The pulses of bromine raise the prospect that the Arctic is contributing gases to the atmosphere. One path for Arctic gases to the stratosphere is through a poorly understood process called tropopause folding. The tropopause is the boundary between the stratosphere, or upper atmosphere, and the troposphere, the lower atmosphere. At times the tropopause over the Arctic is exceptionally low, dipping steeply toward the ground.

"The possibility of mass transport of material in either direction under those conditions is fairly ripe," Berg says. This may be particularly critical in the case of bromine because bromine has a larger catalytic effect on ozone photochemistry, gram per gram, than chlorine. Chlorine is the main trace gas that has been studied for its potential to react with stratospheric ozone and possibly destroy it.

Studies of concentrations of stratospheric bromine and of sources for the gases are underway. If the bromine is biogenic, it may mean that chlorine's role in affecting the ozone layer is less significant than widely believed, and that natural sources may be more involved in keeping the ozone layer in check. —*C. Simon*