July 3, 2025 Aviation Investigation Report: AIR-25-05

Improve Wind Detection Capabilities at Salt Lake City International Airport

Introduction

The National Transportation Safety Board (NTSB) is providing the following information to urge the Federal Aviation Administration (FAA) to take action on the safety recommendations in this report. These recommendations are derived from findings from our investigation of a July 2022 airplane accident in which a cargo pilot encountered a microburst during an attempted go-around that caused the airplane to descend and impact terrain, resulting in minor injury to the pilot and substantial damage to the airplane.[1] The NTSB is issuing two new safety recommendations to the FAA.

Background and Analysis

On July 13, 2022, about 1852 mountain daylight time, a Cessna 208B airplane, N877FE, impacted terrain after encountering a microburst during an attempted go-around at Salt Lake City International Airport (SLC) in Utah. The pilot stated that, after an initial landing attempt, he decided to go around because he was unable to maintain directional control of the airplane due to wind from the left, and he informed the local controller about the go-around. After adding power and climbing to about 30 ft above ground level, he "lowered the left wing" to counteract the drift from the runway centerline. Subsequently, he encountered a microburst that caused the airplane to descend before impacting terrain, off the right side of the runway, in a left-wing-low attitude. The pilot sustained minor injuries, and the airplane sustained substantial damage to the wings and fuselage. The airplane was operated as a Title 14 *Code of Federal Regulations* (*CFR*) Part 135 cargo flight from Friedman Memorial Airport (SUN), Hailey, Idaho, to SLC.[2]

The NTSB determined the probable cause of the accident was the pilot's inability to maintain control of the airplane when it encountered a microburst during a landing

[1] The FAA defines a microburst as a small downburst with outbursts of damaging winds extending 2.5 miles or less that can induce wind speeds as high as 150 knots.

[2] Visit ntsb.gov to find additional information in the public docket for this NTSB investigation (case number WPR22LA251). Use the CAROL Query to search safety recommendations and investigations.

attempt and a go-around near known thunderstorm activity.[3] Contributing to the accident was an inadequate amount of wind sensors and wind shear detection equipment used by the air traffic control (ATC) tower to detect microburst activity at the airport.

At 1848, 4 minutes before the accident, the ATC tower at SLC reported a wind gust of 16 knots; this report, based on information received from automatic terminal information service, only used information from the center field/airport wind sensor, located 8,700 ft north of the accident site.[4] (According to postaccident interviews, this was the only sensor available for distributing tactical wind information to pilots and determining runway configuration.) However, the airport's automated surface observing system (ASOS), located 5,000 ft south-southeast of the accident site, reported wind between 25 and 29 knots with gusts to 48 knots. ATC and the wind shear detection system did not have access to the ASOS wind information, and the pilot was not aware of it. About 1 minute before the accident, the ATC tower broadcasted a blanket wind shear alert, and the airport's wind shear display systems indicated a microburst about 10 minutes after the accident.

Thunderstorms were forecast for SLC in several different weather forecast products, including a terminal aerodrome forecast, graphical forecast for aviation, and a convective Significant Meteorological Information (SIGMET) that was issued after the pilot had departed from SUN and was valid for the accident site. The pilot was aware of thunderstorms west of SLC and used next generation weather radar to track them while en route. He noted, however, that information was delayed by 10 minutes.[5]

A convective SIGMET implies the potential for wind shear, lightning, and severe turbulence, among other things. Rain showers and convective clouds can produce downdrafts, outflow boundaries, and gust fronts during the mature and decaying stages of the convective cloud lifecycle, which can create an environment favorable for unexpected changes in surface wind direction and speed. Flight operations in such conditions can result in pilots' inability to climb out of, or safely transition away from, the

[3] The FAA defines windshear as a sudden, drastic change in wind speed and/or direction over a very small area.

[4] The automatic terminal information service is a continuous broadcast of recorded non-control information in selected terminal areas. Its purpose is to improve controller effectiveness and to relieve frequency congestion by automating repetitive transmissions of essential but routine information.

[5] Although the airplane was equipped with onboard weather radar, the pilot did not turn it on because the altitude of the thunderstorms was outside of the radar's range. In addition, company policy instructed pilots to turn off the radar before landing.

weather, potentially resulting in loss of airplane control. The figure below is a diagram of the lifecycle of a microburst originating from a convective cloud with precipitation.

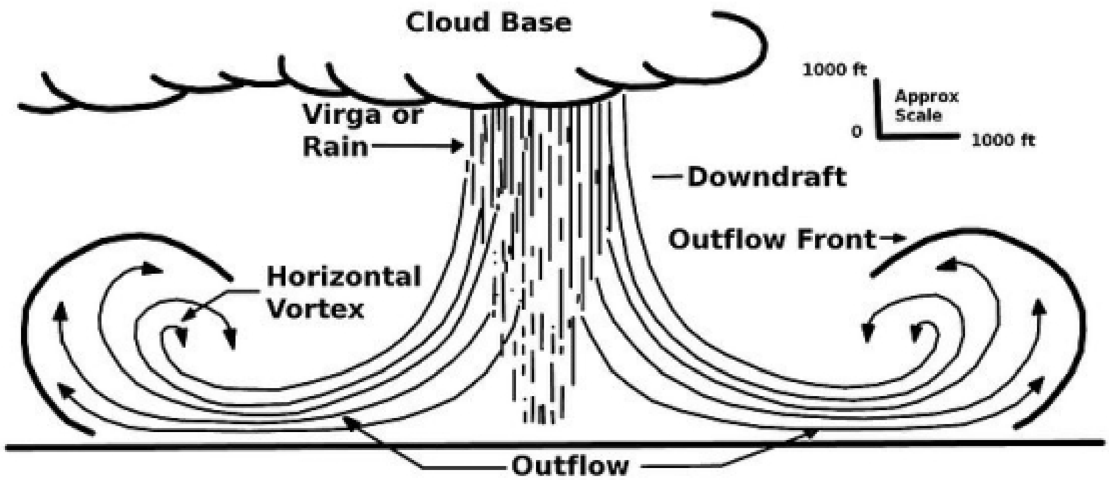

Figure. Diagram of the lifecycle of a microburst. (Source: Advances in Mechanical Engineering)

The NTSB's investigation of this accident found that, in November 2015, SLC ATC management requested that the FAA update the surface weather system and install five additional wind sensors (one for each runway end). However, the request was denied in April 2016 for budgetary reasons.

An event similar to the July 2022 accident occurred in September 2016 when the flight crew of an Embraer ERJ 170/175 ER/LR operating under 14 *CFR* Part 121 diverted after encountering a microburst while on approach to SLC. ATC advised the flight crew of heavy precipitation between the aircraft and the runway and reported that storms were passing, and wind conditions were 16 knots and steady with no low-level wind shear alerts; therefore, the captain decided to attempt a single approach. However, 5 seconds after the airplane intercepted the final approach vector and the captain started configuring flaps, the airplane encountered a microburst, and its airspeed rapidly increased from 190 knots to 234 knots. The airspeed did not return to normal during the approach before the captain diverted and landed the airplane uneventfully.

Similarly, the first officer of a 14 *CFR* Part 121 air carrier submitted an aviation safety reporting system report in December 2016 that wind conditions on the approach to SLC outside the final approach fix were sustained at 40 knots from about 190°.[6] The

[6] The aviation safety reporting system (ASRS) is a national database of voluntary reports submitted by pilots and other aviation professionals to alert others about a potentially unsafe condition or event experienced during line operations. Although ASRS reports are useful for identifying safety issues, they do not provide a basis for determining the magnitude of a problem since additional professionals may experience the same safety issue without submitting a report.

flight then entered an area of precipitation where the wind immediately changed from 190° at 40 knots to 290° at 38 knots. This significant change in wind speed and direction, which is characteristic of a wind shear, resulted in a flap overspeed.[7] The captain immediately executed a go-around and landed the airplane without further incident.

As the circumstances of these events show, the SLC tower's current lack of capability to maintain real-time awareness of microburst activity near and around the airport has led to recurring instances of pilots unexpectedly encountering sudden changes in wind direction and speed. Such encounters have the potential to result in more critical outcomes than the SLC events described.

For example, on August 2, 1985, Delta Air Lines flight 191, a Lockheed L-1011, crashed while approaching to land on runway 17L at Dallas Fort Worth International Airport (DFW), Dallas, Texas. While passing through rain beneath a thunderstorm, flight 191 entered a microburst, which the flight crew was not able to pass through successfully. The airplane struck the ground about 6,300 ft north of the approach end of runway 17L, hit a car on a highway (fatally injuring the driver), and struck two water tanks on the airport before breaking apart. Of the 163 airplane occupants, 126 passengers and 8 crewmembers were fatally injured, 14 passengers and 1 crewmember were seriously injured, 10 passengers and 2 crewmembers sustained minor injuries, and 2 passengers were uninjured. The NTSB determined the probable cause of this accident was, in part, "the lack of definitive, real-time wind shear hazard information."[8] (NTSB 1986).

To improve its wind detection capabilities, DFW began using an integrated terminal weather system (ITWS) in1995. ITWS is composed of algorithms that use data from the terminal doppler weather radar (TDWR) to detect and warn ATC of dangerous wind shear. A low-level wind shear alerting system-network expansion (LLWAS-NE) was also integrated into the ITWS to provide ATC with a complete set of alerts. The 19 individual sensors strategically positioned near all of DFW's runways determine the validity of the wind shear alerts produced by the LLWAS-NE, and the ITWS is able to detect wind shear events that can be missed by the TDWR alone.

The December 20, 2008, accident involving Continental Airlines flight 1404 is another example of an accident resulting from a flight crew's unexpected encounter with

[7] Flap overspeed occurs when an airplane's airspeed exceeds the maximum speed allowed with the flaps extended, often represented by Vfe on the airspeed indicator. This condition can lead to damage or loss of the flaps or other structural damage to the airplane.

[8] The NTSB's full probable cause for this accident was "the flight crew's decision to initiate and continue the approach into a cumulonimbus cloud, which they observed to contain visible lightning; the lack of specific guidelines, procedures, and training for avoiding and escaping from low-altitude wind shear; and the lack of definitive, real-time wind shear hazard information. This resulted in the aircraft's encounter at low altitude with a microburst-induced, severe wind shear from a rapidly developing thunderstorm located on the final approach course."

a sudden change in wind direction and speed. During takeoff from runway 34R at Denver International Airport (DEN), Denver, Colorado, the Boeing 737-500 encountered a strong crosswind and departed the left side of the runway. A postcrash fire ensued. Of the 115 occupants onboard, the captain and 5 passengers were seriously injured; three crewmembers and 38 passengers received minor injuries; and 1 cabin crewmember and 67 passengers (3 of whom were lap-held children) were uninjured. The NTSB determined that a contributing factor to this accident was "an air traffic control system that did not require or facilitate the dissemination of key, available wind information to the air traffic controllers and pilots."[9] (NTSB 2009).

At the time of the accident at DEN, mountain-wave conditions were present that resulted in strong westerly wind conditions and very localized, intermittent wind gusts as high as 45 knots that crossed the airplane's path during the takeoff ground roll.[10] After the accident, the wind sensing capability at the airport was improved to provide wind shear and/or microburst alerts when those conditions are present. The FAA improved DEN's existing LLWAS systems by upgrading software and hardware, integrating the system with the airport's TDWR and ITWS, and adding sensors along runway approach and departure corridors.[11] This airport is also equipped with the LLWAS-NE rehost system, which is designed to continuously collect and analyze wind data from 32 remote sensor stations located on and around the airport.[12] The improved wind sensing capability has enabled ATC personnel to support pilots in making more informed decisions before departing and landing.

SLC is located downwind of mountainous terrain and is susceptible to similar mountain-wave-related wind hazards as DEN. However, SLC currently lacks similar wind detection capabilities, which provide real-time detection of wind shear, microbursts, gust

---

[9] The NTSB's full probable cause for this accident was "the captain's cessation of right rudder input, which was needed to maintain directional control of the airplane, about 4 seconds before the excursion, when the airplane encountered a strong and gusty crosswind that exceeded the captain's training and experience. Contributing to the accident were the following factors: 1) an air traffic control system that did not require or facilitate the dissemination of key, available wind information to the air traffic controllers and pilots; and 2) inadequate crosswind training in the airline industry due to deficient simulator wind gust modeling."

[10] According to information in FAA-H-8083-28A, *Aviation Weather Handbook*, mountain waves are characterized by a series of upward and downward motions in the atmosphere. These motions can extend both vertically and horizontally for considerable distances downwind.

[11] DEN's ITWS continuously gathers information from LLWAS, ASOS, and other airport weather data sources and integrates and displays the information for use by DEN ATC personnel. If wind shear and/or microburst conditions do exist, related alerts are displayed to air traffic controllers on the ribbon display terminals in the tower.

[12] The 32 sensors report wind information at 10-second intervals and are positioned to provide wind speed and direction for all runway surfaces to determine whether wind shear and/or microburst conditions exist.

fronts, and wind shifts. The installation of an LLWAS-NE system along with the addition of wind sensors placed at the various runways at DEN, as well as DFW, has improved aircraft efficiency and overall safety by preventing wind shear-related aircraft accidents, and could do the same at SLC.

Therefore, the NTSB concludes that SLC's susceptibility to convective, mountain-wave, and additional wind-related hazards warrants an enhancement of its current wind detection capabilities to improve tower controllers' awareness of such hazards and their ability to alert pilots before departure and arrival. Therefore, the NTSB recommends the FAA install an LLWAS-NE system at SLC and add the appropriate number of wind sensors based on land area coverage and terrain features to detect and warn of microburst activity.

The NTSB notes that these weather-related concerns may apply to other Part 139 airports and concludes that wind sensing capabilities at other Part 139 airports may need to be similarly enhanced to support tower controllers' ability to alert pilots about wind hazards in a timely manner. Therefore, the NTSB recommends, as part of its ATC modernization efforts, the FAA ensure that all Part 139 airports within the National Airspace System that are susceptible to mountain wave and convective-related wind hazards have sufficient wind detection capabilities to warn of windshear and microburst activity in real time.

Conclusions

Findings

Salt Lake City International Airport's susceptibility to convective, mountain-wave, and additional wind-related hazards warrants an enhancement of its current wind detection capabilities to improve tower controllers' awareness of such hazards and their ability to alert pilots before departure and arrival.

Wind sensing capabilities at other 14 *Code of Federal Regulations* Part 139 airports may need to be similarly enhanced to support tower controllers' ability to alert pilots about wind hazards in a timely manner.

New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations.

To the Federal Aviation Administration:

Install a low-level wind shear alerting system-network expansion at Salt Lake City International Airport and add the appropriate number of wind sensors based on land area coverage and terrain features to detect and warn of microburst activity. (A-25-34)

Ensure that all Title 14 *Code of Federal Regulations* Part 139 airports within the National Airspace System that are susceptible to mountain wave and convective-related wind hazards have sufficient wind detection capabilities to warn of windshear and microburst activity in real time. (A-25-35)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JENNIFER L. HOMENDY
Chairwoman

MICHAEL GRAHAM
Member

THOMAS CHAPMAN
Member

J. TODD INMAN
Member

Report Date: July 3, 2025

References

National Transportation Safety Board (NTSB). 1986. *Delta Air Lines, Inc., Lockheed L-1011-385-1, N726DA Dallas/Fort Worth – International Airport, Texas August 2, 1985*. AAR-86-05. Washington, DC.

NTSB. 2009. *Runway Side Excursion During Attempted Takeoff in Strong and Gusty Crosswind Conditions Continental Airlines Flight 1404 Boeing 737-500, N18611 Denver, Colorado December 20, 2008*. AAR-10-04. Washington, DC.

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable cause of the accidents and events we investigate and issue safety recommendations aimed at preventing future occurrences. We also conduct safety research studies and offer information and other assistance to family members and survivors for any accident investigated by the agency. Additionally, we serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties … and are not conducted for the purpose of determining the rights or liabilities of any person" (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)).

Recent publications are available in their entirety on the NTSB website. Other information about available publications also may be obtained from the website or by contacting—

National Transportation Safety Board
Records Management Division, CIO-40
490 L'Enfant Plaza, SW
Washington, DC 20594
(800) 877-6799 or (202) 314-6551