Australian Government
Australian Transport Safety Bureau

Severe turbulence and loss of control involving a Cessna 210M, VH-SJW

30 km south of Darwin Airport, Northern Territory on 25 November 2019

ATSB Transport Safety Report
Aviation Occurrence Investigation
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Addendum

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Safety summary

What happened

On 25 November 2019, a Cessna 210M, registered VH-SJW and operated by Mistar Holdings, was conducting a charter flight with four passengers from Darwin to Tindal, Northern Territory. Soon after departure, the pilot diverted 5 NM right of the planned track to avoid a large storm cell that was 5 NM left of track. About 10 minutes after departure, while maintaining 3,500 ft, the aircraft encountered sudden and sustained severe turbulence. Control of the aircraft was lost for over 3 minutes, and three passengers sustained minor injuries.

After landing at Tindal and inspecting the aircraft for potential damage, the pilot ferried the aircraft to Millingimbi. At Millingimbi, the pilot picked up four more passengers for a charter to Galiwin'ku (Elcho Island). The pilot reported the incident to the operator that evening. Upon receiving notification of the turbulence encounter, the operator grounded VH-SJW at Galiwin'ku, pending an engineering inspection.

What the ATSB found

At 10 NM from the thunderstorm, the pilot did not have sufficient separation to ensure safe passage.

Following the incident, the inspection carried out by the pilot was not sufficient to ensure the airworthiness of the aircraft beyond doubt. Flying another charter flight without an aircraft inspection by a qualified person exposed the operator, the pilot, and the passengers to elevated risk. In addition, the operator did not have guidance to direct pilots to seek advice or peer support following abnormal events.

What has been done as a result

The operator has developed case studies for pilots, emphasising weather avoidance and management of abnormal events. These have been integrated into proficiency checks to ensure solid understanding of theory, and practical application of weather avoidance, escape and post encounter management.

Safety message

The primary protection against thunderstorm related turbulence is avoidance. In this case, 10 NM was not far enough. Operators, pilots and passengers can work together to avoid flying in adverse weather. For instance, by starting a day's flying early it can be completed before weather becomes a problem in the afternoon.

A pilot with the best intentions may make a suboptimal decision after experiencing an abnormal event. Operators can provide guidance to assist pilots to make good decisions in these situations, by providing peer support and emphasising the importance of reporting abnormal events in a timely manner. Early reporting reduces pressure in operations, allowing ample time to make alternative arrangements.

To support continuous improvement in performance, pilots should regularly review operational documents and industry advice, to build on experience, and develop a comprehensive knowledge of issues and strategies available.

The investigation

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope investigation was conducted in order to produce a short investigation report, and allow for greater industry awareness of findings that affect safety and potential learning opportunities.

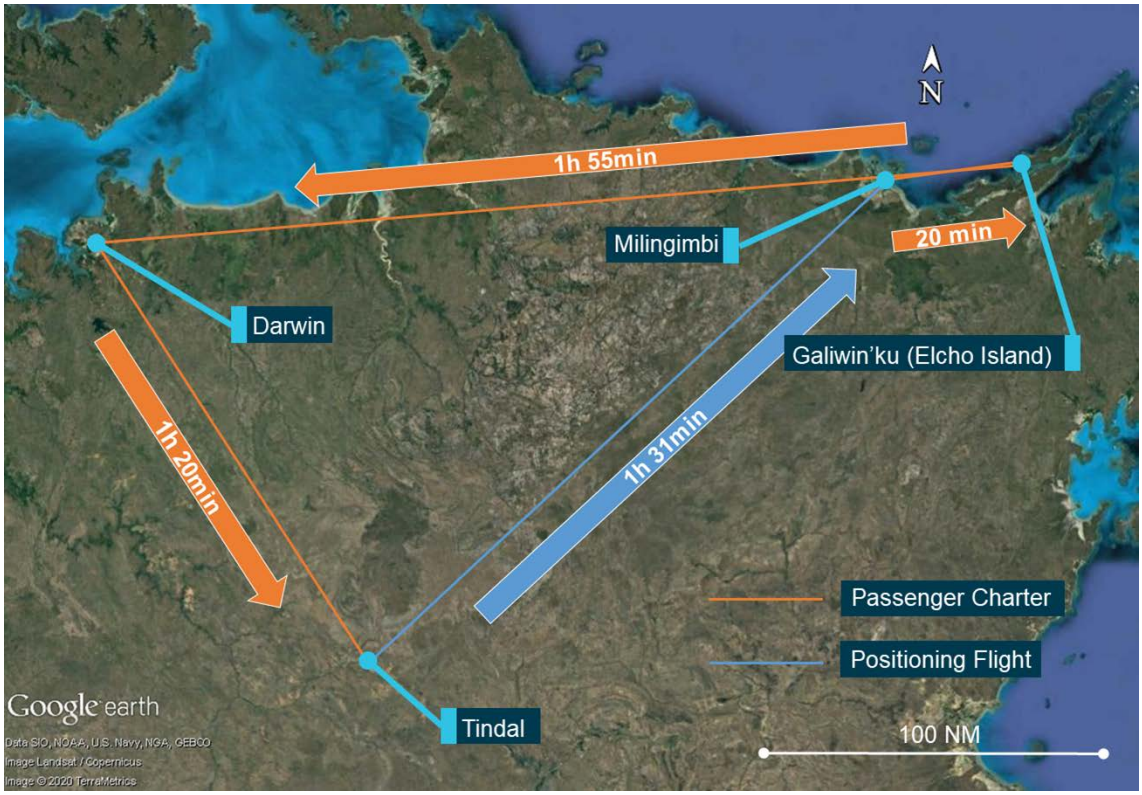
The occurrence

Planned flights

On 25 November 2019, at 1119 Central Standard Time,[1] a Cessna 210M, registered VH-SJW and operated by Mistar Holdings, departed Galiwin'ku (Elcho Island), Northern Territory, for a passenger charter flight with the pilot and three passengers on board. The flight had a planned stopover in Darwin, to collect another passenger, before continuing on to Tindal. From Tindal, the pilot planned to fly to Millingimbi empty, collect passengers, and return to Galiwin'ku (Figure 1). The flights were being conducted under visual flight rules (VFR).

The pilot briefed the passengers that seatbelts were to be worn at all times, and that they should be tight. The pilot visually checked the passenger's seat belts before departure.

Figure 1: Charter flight route for VH-SJW



Source: Google Earth, annotated by the ATSB

Turbulence encounter

As per the forecast, on approach into Darwin Airport, the pilot noticed a large thunderstorm to the south of the city crossing the intended departure track. After landing at Darwin, the passengers disembarked and had about a 30-minute break before boarding the aircraft again.

[1] Central Standard Time (CST): Coordinated Universal Time (UTC) + 9.5 hours.

The pilot accepted a departure delay from air traffic control (ATC) of 28 minutes. The air traffic controller recalled that multiple aircraft were requesting diversions due to storm activity. During this time, the pilot reviewed graphical area forecasts issued by Airservices Australia, and used Bureau of Meteorology weather radar to track the progress of the storm cell.

The aircraft departed Darwin at 1418 and the pilot was cleared to depart via VFR route 4. The pilot had identified that the storm cell was about 5 NM left of the planned track, so requested a diversion of 5 NM right of track to provide a 10 NM separation from the weather. ATC approved the pilot's request. One of the passengers photographed the weather after they diverted (Figure 2).

Figure 2: Photograph taken by right centre row passenger

Source: Supplied by passenger aboard VH-SJW

About 10 minutes after take-off, the pilot reported maintaining an altitude of 3,500 ft. At about this time, and shortly after the photograph was taken, the aircraft was subjected to sudden severe turbulence.[2] The mobile phone used to take the photograph fell under the pilot's rudder pedals with the first significant drop in altitude. The pilot's checklist and an iPad were also loose in the cabin.

The pilot was wearing a four-point harness and the passengers, seated in the centre and rear rows, all wore lap belts. There was no facility for the pilot and passengers to communicate over an intercom. Due to the high noise environment in the aircraft cabin, the pilot could only communicate with passengers using hand signals. As a result, the passengers were not warned of potential turbulence, or instructed to check their seatbelts were tight, and stow loose items.

The pilot reported tightening their own harness and initially aimed to climb to 4,500 ft, hoping to climb over the turbulence. This strategy changed in order to retain visual meteorological conditions.

[2] Severe turbulence: turbulence resulting in an inability to control the aircraft.

Turbulence penetration speed[3] for the Cessna 210M was 119 kt. The pilot stated that, during the incident, airspeed could not be controlled through changing power settings, and for the most part the airspeed could not be held below 155 kt. For extended periods, the pilot had no control over bank angle, height, or heading. At one stage, the airspeed dropped below 140 kt, and the pilot lowered the landing gear in order to create drag and slow the aircraft down.

The backrest of the centre row of seats in VH-SJW could be folded forwards for access to the rear row of seats, which was standard. One centre row passenger found it difficult to brace against the moveable seat back, and though wearing a seatbelt, reported not being sufficiently secure. This passenger's neck was injured in the incident.

The turbulence encounter lasted about 3.5 minutes. Radar at Darwin recorded the aircraft's highest groundspeed as 210 kt, and rate of descent at one point to be 5,000 ft/minute with a lowest altitude of 1,200 ft.

The pilot gave the passengers a 'thumbs-up' indication when control was returned, and continued to Tindal Airport in mild turbulence and rain.

After landing

The aircraft landed at Tindal Airport at 1538, and the passengers disembarked 5 minutes later. The passengers reported that the pilot asked if they were okay, but said the pilot did not de-brief them on the incident other than to say that it was normal turbulence. The pilot did not report the turbulence encounter to the operator or the ATSB.

A passenger stated that the group was distressed by the incident and, with no debriefing or advice, they went directly to their accommodation. In retrospect, the passenger believed the group should have instead gone to hospital to be checked over. Three of the passengers later visited hospital for shoulder and neck injuries, and one case of damage to a pre-existing leg injury.

Recognising the potential for damage to the aircraft from the turbulence encounter, the pilot reported conducting a thorough daily inspection at Tindal. The pilot spent a total of 31 minutes on the apron at Tindal before departing for Milingimbi at 1614. At Milingimbi, the pilot met four passengers and flew them to Galiwin'ku.

At Galiwin'ku, the pilot told the operator's base manager about the turbulence encounter. The base manager advised the pilot to contact the head of flight operations (HOFO). The pilot did so and the HOFO instructed the base manager to ground the aircraft and ordered an engineering inspection of the aircraft for flight under abnormal loads. An engineer carried out the inspection the following day and returned the aircraft to service after finding no defects.

Context

The pilot

The pilot of VH-SJW held a commercial pilot licence (aeroplane) and had 802 hours' aeronautical experience, with 550 hours as pilot in command, and had flown in the region for the operator for 11 months. Upon commencement with the operator in December 2018, the pilot underwent a course of training designed to bridge the gap between commercial licence training and commercial operations in general aviation. This included exposure to decision making around adverse weather.

Weather information

Meteorological conditions over the northern half of Australia are favourable for thunderstorms from October through to March. Abundant moisture and instability is present through most of the Wet Season. During this time, low pressure lies across northern and central Australia, giving rise low-

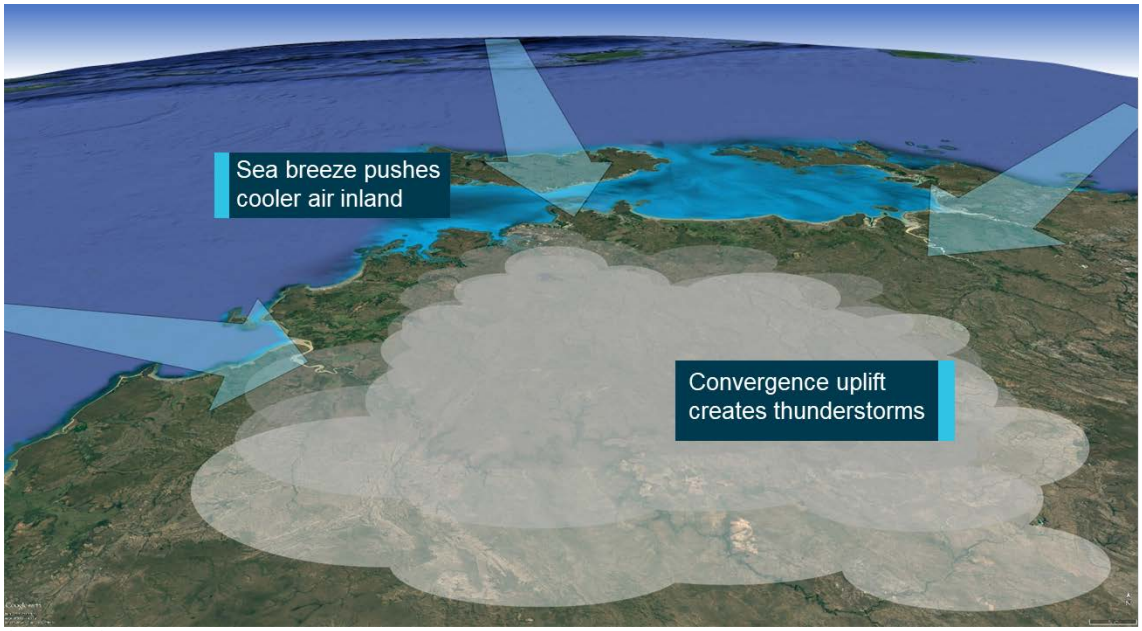
[3] Turbulence penetration speed: an airspeed designed to protect the airframe from overstress in turbulent conditions.

level convergence and vertical motion necessary for thunderstorm development. During these months, thunderstorms during the afternoon are a common occurrence due to the convergence of sea breezes with an east to south-easterly synoptic wind regime (Figure 3).

The Bureau of Meteorology, in its guide Flying the Tropics (2012), stated:

> The convective cloud bases can be very high (sometimes up to 15 000 feet), with very severe downdraughts from the cloud base to the surface. For this reason flights should never be conducted under or through precipitation (including virga) from towering cumulus or cumulonimbus clouds.

Figure 3: Mechanism of local storm generation



Source: ATSB

The weather forecast for Darwin received by the pilot before departure stated:

> PROB30 TEMPO 2505/2514 VRB20G45KT 1000 THUNDERSTORMS WITH MODERATE RAIN BKN010 SCT025CB

That translated as a 30 per cent probability of thunderstorms for periods of at least 30 minutes but less than 60 minutes, and wind variable in direction with gusts up to 83 km/h (45 kt), accompanied by low cloud and rain with low visibility around Darwin from 1430 local time onwards. Tindal shared similar predicted conditions although any thunderstorms were expected for periods of less than 30 minutes.

The routine report of meteorological conditions at Darwin Airport at the time VH-SJW was readying for departure stated:

> METAR YPDN 250430Z 31010KT 9999 VCSH FEW045 FEW045CB 34/21 Q1008 TEMPO 0530/0730 VRB20G45KT 1000 TSRA BKN010 SCT025CB RMK RF00.0/000.0

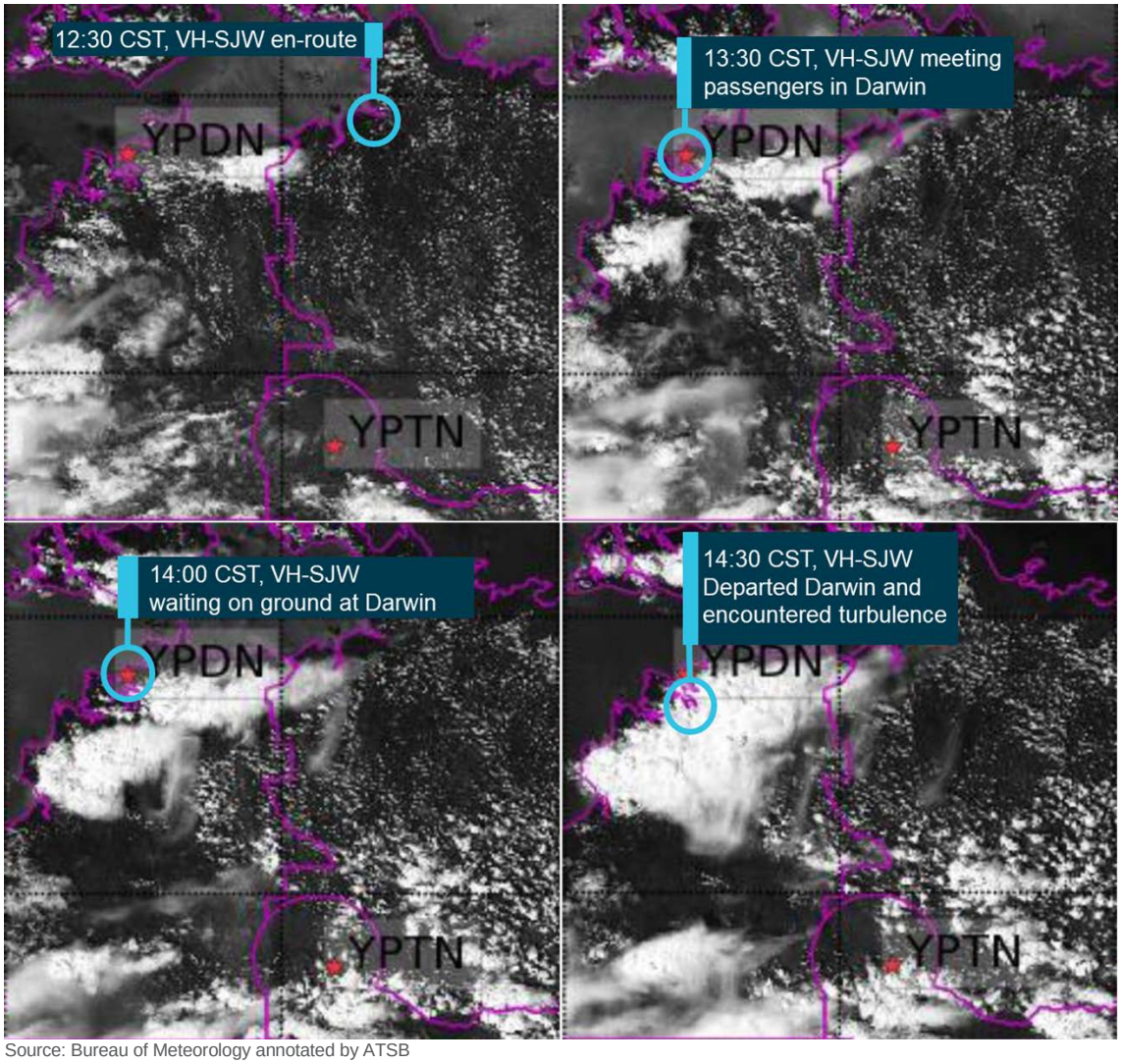
This translated as surface wind from the north-west at 18 km/h. Visibility was 10 km or greater, with showers in the vicinity of the airport. Cloud at 4,500 ft covered up to one half of the sky, and the layer included embedded cumulonimbus. The air temperature was 34 °C and the pressure (QNH) was 1,008 hPa. Additionally, a trend forecast was included with the report, warning of the expectation of periods of thunderstorms. These would have low cloud at 1,000 ft covering three quarters of the sky and cumulonimbus at 2,500 ft covering up to half the sky, bringing rain with variable wind gusting from 35 to 83 km/h, and reduced visibility of 1,000 m.

The pilot used information from a Bureau of Meteorology high-resolution Doppler radar, located 5.5 NM to the east of Darwin, to aid awareness of the weather conditions. There are however, limitations to that technology. Heavy rain closer to the radar will absorb energy and reduce the displayed intensity of other cells behind it. Additionally, the image is a composite of the last 6 to 10

minutes of data and shows where the weather was, not where it is. A cell could be much closer and more intense than displayed.

Figure 4 shows satellite images that captured the build-up of thunderstorm activity on the day. In the first frame at 1230 Darwin (YPDN) is relatively clear of cloud. After VH-SJW arrives in Darwin, the next hour shows significant build-up of cloud on VH-SJW's intended track to Tindal (YPTN).

Figure 4: Satellite images of thunderstorm development at the time



Source: Bureau of Meteorology annotated by ATSB

Procedures and guidance

In August 2019, the operator amended its operations manual with a section titled 'Adverse weather operations'. This section required pilots to avoid thunderstorms by 20 NM during the cruise phase of flight. The pilot had signed to confirm receipt of the operations manual amendment on the day it was issued. The operator also created a training program to support the amendment. The pilot had not received the training before the incident flight.

The safety message of ATSB report AO-2017-102,[4] an investigation of a fatal turbulence penetration event involving a Cessna 210 in the Northern Territory, stated that diversions of 10 NM may not be sufficient. That report was presented by an ATSB investigator in the pre-season Top-End safety briefing hosted by the Civil Aviation Safety Authority in Darwin on

[4] ATSB AO-2017-102, In-flight breakup involving Cessna 210, VH-HWY, 22 km east of Darwin Airport, Northern Territory, on 23 October 2017.

9 October 2019. The operator's pilots on Galiwin'ku (Elcho Island) could not attend, and instead got together to watch the 2018 briefing which was available via the internet.

In interview, the HOFO stated that pilots were encouraged to report incidents, and in some cases, such as for birdstrike, there were written requirements and instructions for reporting and managing the event. Even though the operator provided pilots with extensive guidance on avoidance of adverse weather, the HOFO stated that there was no formal guidance for the actions for pilots to follow after encountering severe turbulence.

Safety analysis

Anticipating and avoiding turbulence

The primary tool for reducing the risk of turbulence encounters of this type is avoidance of the associated weather phenomenon. Advice existed for the pilot in the operations manual that a 20 NM separation was required. A previous ATSB investigation report stated that 10 NM separation may not be enough, and a recent seminar repeated the message. Unfortunately, partially due to the reality of remote area operations, the pilot missed these recent reminders.

By diverting 5 NM right of track, and being 10 NM from the cell, the pilot was still too close to the weather phenomenon. Although the extent of loss of control was unexpected, some turbulence could be reasonably foreseen.

The pilot was well secured by wearing a harness, yet the passengers and cabin were not sufficiently prepared. The brief before flight stated that seatbelts were to be worn at all times, and that they should be tight, and the pilot conducted a visual check before departure. During flight when turbulence is anticipated or encountered, these instructions should be repeated with instruction to stow all loose items. In this case, an inability to communicate via intercom with the passengers while airborne limited the pilot's ability to prepare the cabin.

Post incident reporting

A loss of control due to weather is an immediately reportable matter for an air transport operation under Regulation 2.3 (3)(s) of the *Transport Safety Investigation Act 2003*. In accordance with section 18 of this Act, the occurrence must be reported as soon as is reasonably practicable to the ATSB by telephone and a follow up written report must be made within 72 hours. The requirement to ensure a report is made resides with all responsible persons having knowledge of the occurrence.

The pilot did not report the turbulence encounter to the operator until after the last flight. From that point, the pilot and operator both had a responsibility to report the encounter to the ATSB. The encounter was reported by the operator 7 days after it occurred. It is important for preservation of perishable evidence that occurrences are reported as soon as practicable.

Operational support and management of risk

During the turbulence encounter and loss of control, the pilot was sure that no airframe limitations were exceeded. If the limitations were not exceeded, the pilot was not legally required to cease operations in that aircraft. However, when encountering such a high level of turbulence, the aircraft instruments may not present an accurate picture of what the aircraft experiences. It was reasonable to assume that airframe limitations could have been exceeded.

A pilot may not recognise or appreciate the implications of an abnormal event until a much later time. An objective view from a peer or senior person can lead pilots to make better decisions after an abnormal event.

Without formal guidance as to next steps following an encounter with severe turbulence, the pilot did not report the incident, or seek outside input into decision-making. Subsequently, the pilot prescribed a suboptimal inspection for the circumstances. The pilot did recognise the potential for damage, and inspected the aircraft to the extent that a pilot could. Licenced aircraft maintenance

engineers are qualified to inspect aircraft for abnormal flight loads, yet the pilot did not consider such an inspection was necessary. Although the later engineering inspection found no defects, continuation of flight without an appropriate inspection exposed the pilot, operator, and passengers to additional, avoidable risk.

The operator demonstrated active risk management by grounding the aircraft to ensure its airworthiness after receiving a report of the occurrence. This set a visible benchmark of risk tolerance, which if supported by formal guidelines, would clearly set the operator's expectations of its pilots.

Even in remote areas, pilots are not expected to manage the safety of a flight on their own, and facilities exist for pilots to enlist support and seek alternative solutions. Operators should ensure that there are well-communicated and structured solutions in place.

On the operational level, reporting issues as early as possible gives an operator time to develop alternative solutions for customers, which takes any acquired operational pressure away from the pilot. This supports pilots in cautious decision-making.

Another tool to assist in pilot decision-making is passenger debriefing. It is an opportunity for the pilot and passengers to process the occurrence and develop strategies for next steps and future avoidance.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the turbulence encounter and loss of control involving VH-SJW on 25 November 2019.

Contributing factors

- Although the pilot diverted 5 NM right of track to avoid a large storm cell that was 5 NM left of track, the 10 NM separation from the storm was not sufficient and the aircraft encountered severe turbulence, resulting in a loss of aircraft control.

Other factors that increased risk

- The operator provided no formal guidance to pilots with respect to immediate reporting of abnormal events, and the pilot did not make an immediate report.
- The pilot flew another passenger charter flight in the incident aircraft before reporting the turbulence encounter and loss of control to the operator. Upon receiving the notification, the operator immediately grounded the aircraft for a precautionary airframe inspection.

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- pilot of VH-SJW
- passengers aboard VH-SJW
- Mistar Holdings (operator of VH-SJW)

- Department of Defence (air traffic control provider)
- Bureau of Meteorology
- Civil Aviation Safety Authority.

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- pilot of VH-SJW
- Mistar Holdings
- Bureau of Meteorology
- Civil Aviation Safety Authority
- Department of Defence.

Submissions were received from the Bureau of Meteorology and Mistar Holdings (safety action only). The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

General details

Occurrence details

Date and time:	25 November 2019 – 1345 CST	
Occurrence category:	Serious incident	
Primary occurrence type:	Turbulence encounter	
Location:	30 km south of Darwin Airport, Northern Territory	
	Latitude: 12º 38.092' S	Longitude: 130º 56.058' E

Aircraft details

Manufacturer and model:	Cessna 210M	
Registration:	VH-SJW	
Operator:	Mistar Holdings	
Serial number:	21062219	
Type of operation:	Commercial	
Activity:	Passenger Charter	
Departure:	Darwin Airport, NT	
Destination:	Tindal Airport, NT	
Persons on board:	Crew – 1	Passengers - 4
Injuries:	Crew – 0	Passengers – 1 nil, 3 minor
Aircraft damage:	None	