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Avoidable Accidents No. 4

# Accidents involving pilots in Instrument Meteorological Conditions



Australia's national transport safety investigator

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# Introduction

Weather-related general aviation accidents remain one of the most significant causes for concern in aviation safety; the often-fatal outcomes of these accidents are usually all the more tragic because they are avoidable.

In the 5 years 2006–2010, there were 72 occurrences of visual flight rules (VFR) pilots flying in instrument meteorological conditions (IMC) reported to the ATSB. Seven of these resulted in fatal accidents, causing 14 fatalities. That is, about one in ten VFR into IMC events result in a fatal outcome.

Flying into IMC can occur in any phase of flight. However, a 2005 ATSB research publication *General Aviation Pilot Behaviours in the Face of Adverse Weather* concluded that the chances of a VFR into IMC encounter increased as the flight progressed, with the maximum chance occurring during the final 20 per cent of the flight distance.

The dangers of flying VFR into IMC have been recognised for a long time, yet VFR pilots still fly into deteriorating weather and IMC. This publication describes recent weather-related general aviation accidents and incidents that show that weather alone is never the only factor affecting pilot decisions that result in inadvertent IMC encounters. It has been produced solely with the intention of encouraging all pilots, no matter what their experience level, to develop the knowledge and skills required to avoid unintentional operations in IMC.

## Key messages

- » Avoiding deteriorating weather or IMC requires thorough pre-flight planning, having alternate plans in case of an unexpected deterioration in the weather, and making timely decisions to turn back or divert.
- » Pressing on into IMC conditions with no instrument rating carries a significant risk of severe spatial disorientation due to powerful and misleading orientation sensations in the absence of visual cues. Disorientation can affect any pilot, no matter what their level of experience.
- » VFR pilots are encouraged to use a 'personal minimums' checklist to help control and manage flight risks through identifying risk factors that include marginal weather conditions.

# Flight planning requirements

Prior to a flight, a pilot must study all available information appropriate to the intended operation, including the current weather forecasts. This is even a requirement in the Civil Aviation Regulations (CAR 174) and repeated in the Aeronautical Information Publication. Apart from the more straightforward and mechanical elements of the flight preparation, such as how much fuel to carry, planning should include anticipating the unusual, and preparing a course of action should it occur. Pre-flight planning minimises in-flight decision errors because it removes the unforeseen element from situations that arise during the flight. Failure to carry out this prior planning can result in decisions being made under a situation of considerable stress and increases the likelihood of poor or incorrect decision making.



Source: ATSB





Source: ATSB

## No way out

Investigation AO-2008-083

In December 2008, a Cessna 172 aircraft with a pilot and one passenger departed Mudgee, New South Wales (NSW) on a private VFR flight to a property near Glen Innes, NSW. Although the pilot visually assessed the weather conditions at Mudgee Aerodrome as suitable for departure, he chose not to obtain the relevant aviation weather forecasts for the flight.

About 15 minutes after departure, the weather ahead deteriorated, with increasing cloud above and below the aircraft and the cloud base lowering. With the intention of assessing the weather ahead, the pilot climbed the aircraft to 'on top' of the cloud. He observed that the cloud ahead was increasing, with a blanket of cloud below and building thunderstorms. The pilot decided not to stay above the cloud, but rather than choosing to turn back or divert, descended the aircraft visually through a hole in the cloud, while continuing on toward the intended destination.

When the pilot levelled out, he realised he had descended into a closed valley framed by ridgelines on its eastern, western and northern sides. After flying up the valley for a short time, the pilot decided to turn back. During the turn-back manoeuvre, the aircraft entered cloud, the pilot became disoriented and the aircraft collided with terrain. The pilot and passenger were seriously injured in the collision and shortly after, the passenger succumbed to his injuries.

### Lessons learnt

*One of the key risk controls to avoid becoming a VFR pilot entering IMC is appropriate pre-flight preparation and planning. Pilots should always obtain up-to-date weather information before and during flight. The more doubtful the weather, the more information you will need to get and the more planning is required. Your passengers trust you to make responsible decisions about whether it is safe to fly.*

*Even though you may have decided on a course of action, decision making is a dynamic process, particularly when it comes to weather, and requires continuous assessment of conditions en route. Make decisions early – when in doubt, turn about.*



Wreckage of the Gippsland Aeronautics GA-8 Airvan

Source: Michael Patterson

## Hazardous landing

Investigation AO-2010-080

In October 2010, the pilot of a Gippsland Aeronautics GA-8 Airvan, was conducting a charter flight from Lady Barron Aerodrome, Flinders Island, Tasmania. The forecast weather was marginal for flight under the VFR, with broken<sup>1</sup> cloud forecast down to 500 ft above mean sea level in the area. However, the pilot's assessment from the ground was that the cloud base was 1,000 ft to 1,500 ft. During the climb after takeoff, the weather conditions deteriorated to below those necessary for flight under the VFR. The pilot, concerned about adhering to an unwritten operator rule to maintain a minimum height of 1,000 ft, continued to climb into IMC instead of remaining visual below the cloud and lost all visual reference with the ground and horizon.

The pilot, who was not qualified to fly in instrument meteorological conditions, continued to fly in IMC for several minutes in the hope that he would climb above the cloud. When this did not happen, he decided to turn the aircraft back towards Lady Barron Aerodrome, initiating a gentle turn to the right. He succeeded in maintaining controlled flight with reference to the aircraft's flight instruments. However, although intending to turn through 180°, the pilot inadvertently turned less than this and steered towards high ground in the Strzelecki National Park.

When the pilot finally became visual, he turned the aircraft into a valley in which he could neither turn around nor out-climb the terrain. The pilot elected to conduct a forced landing into the tree tops, slowing the aircraft to land at the slowest speed possible. Luckily, only one passenger sustained minor injuries and the pilot and other five passengers were uninjured. The aircraft's occupants were winched to safety by helicopter during the night after spending several hours in the cold.

<sup>1</sup> Broken cloud refers to cloud coverage of 5 to 7 eighths of the total visible sky.

## Lessons learnt

*The result could easily have been a fatal accident. If you encounter deteriorating weather, turn back or divert before you are caught in cloud. For a non-instrument rated pilot, even with basic attitude instrument flying proficiency, maintaining control of an aircraft in IMC by reference to the primary flight instruments alone entails a very high workload that can result in narrowing of attention and loss of situational awareness ('staying ahead of the aircraft'). The fact that you are outside the visual flight rules criteria may be a clue that you are losing or have lost situational awareness.*

*Pilots often choose to take off and assess the weather as they go. If you are confident that you can depart in visual conditions and return safely should conditions deteriorate ahead, then departing is a safe option. In the event that you are inadvertently caught out by the weather, remember that the regulations regarding minimum heights to fly do not apply if 'through stress of weather or any unavoidable cause it is essential that a lower height be maintained'.*



## Spatial disorientation

In order to correctly sense the orientation of the body relative to its environment, a pilot relies on a number of sensory systems in order to establish or maintain orientation:

- » the visual system
- » the vestibular system, which obtains its information from the balance organs in the inner ear
- » the somatic sensory system which uses the nerves in the skin and proprioceptive senses in our muscles and joints to sense gravity and other pressures on the body.

The visual system is by far the most important of the three systems, providing some 80 per cent of the raw orientation information. In conditions where visual cues are poor or absent, such as in poor weather, up to 80 per cent of the normal orientation information is missing. Humans are then forced to rely on the remaining 20 per cent, which is split equally between the vestibular system and the somatic system. Both of these senses are prone to powerful illusions and misinterpretation in the absence of visual references, which can quickly become overpowering.

Pilots can rapidly become spatially disoriented when they cannot see the horizon. The brain receives conflicting or ambiguous information from the sensory systems, resulting in a state of confusion that can rapidly lead to incorrect control inputs and resultant loss of aircraft control. Simulator experiments at the University of Illinois determined that on average, a pilot with no instrument training can expect to retain control of their aircraft for only 178 seconds after entering bad weather and losing visual contact.





Wreckage of the Bell 206L helicopter

Source: ATSB

## Engulfed by cloud

Investigation AO-2009-077

In December 2009, a Bell 206L helicopter was being operated in the area of Dorrigo, NSW, conducting fire observation, water bombing and personnel insertion duties under the visual flight rules. The cloud in the area of the helicopter landing and take-off point at around the time of the accident was fluctuating around the minimum required for flight under the visual flight rules.

Shortly after becoming airborne on the second flight of the day, the pilot lost all visual references outside the cockpit and became spatially disoriented, rapidly leading to incorrect control inputs, loss of control and impact with the ground. The passenger was fatally injured and the pilot was seriously injured.

The experienced pilot recalled that, during the initial takeoff, he raised the helicopter into a low hover and conducted a pedal turn through 360° to get a better look at the weather and establish an appropriate departure direction. He said that the weather looked better in the low hover than it did on the ground, so he elected to climb to about 100 ft into a high hover.

The pilot reported that he looked inside the cockpit to survey his instruments for a couple of seconds and, when he looked outside again, all visual reference was lost. He recalled that cloud had blown in under the helicopter and that he could not see anything outside the helicopter.

### Lessons learnt

*Relying on the option to immediately land a helicopter in open ground if visual reference is lost is a strategy that does not take into account the in-general dynamic instability of a hovering helicopter. Even momentary loss of outside visual reference can result in spatial disorientation, incorrect control inputs, and loss of control.*

*Whenever the natural horizon is not clear enough to control the aircraft by visual reference, such as often occurs in marginal VMC, all pilots, no matter what their flight experience level, are potential victims of spatial disorientation. If in doubt, don't fly.*

# Into the void

Investigation AO-2007-061

In November 2007, the pilot of a Cessna 337 Skymaster was conducting a private VFR flight from Moorabbin Airport, Victoria to Merimbula, NSW. The pilot, who was only qualified to operate in VMC, had indicated that he would be tracking along the coast at low level. The forecast weather included isolated showers or thunderstorms over the sea and coast, and low cloud over the sea/exposed coast. The low cloud was expected to be broken stratus between 800 ft and 2,000 ft. Visibility was quoted as reducing to 3 km in thunderstorms with rain and 6 km in showers of rain.

About 30 minutes after departing Moorabbin, people on a beach south-east of Venus Bay heard and then suddenly saw the aircraft emerge from fog at low level, flying above the water line on the beach with the wings level. Within seconds it turned right at a steep angle of bank while maintaining height and headed out to sea before disappearing from sight into the fog. The witnesses reported no apparent problem with the engines and the aircraft appeared to be under control. About 2 seconds after the aircraft disappeared from view, they heard a ‘bang’ and then silence.

Two days later, wreckage of the aircraft and three of the deceased occupants were found washed up on the beach. The pilot was not found.

The investigation concluded that while manoeuvring over water at low level in conditions of reduced visibility, the pilot probably became spatially disorientated and inadvertently descended into the water.

By turning away from the land in the foggy conditions, the pilot would have encountered a featureless, grey environment with no visible horizon, making it extremely difficult for him to judge the aircraft’s attitude and/or height.

## Lessons learnt

*It should be accepted that flying under the VFR will not always enable you to reach your planned destination. Weather often does not act as the forecast predicts. You must have alternatives available and you must be prepared to use them — even if it means returning to your departure point.*

*In forecast marginal weather, careful pre-flight planning is essential and must include a thorough analysis of the latest weather forecasts and consideration of your available options. Those options should be evaluated while en route to ensure you have an alternative course of action available which provides for a safe landing.*



Source: Heidi Willems

## Personal limitations

When deciding on whether it is safe to fly you should consider not only the route to be flown, the prevailing weather and aircraft serviceability, but your own physical and emotional fitness and flying experience. In other words, to be a competent pilot you must know and fly within your own limitations. Adhering to a pre-flight 'personal minimums' checklist will go a long way toward keeping you safe. For example, the decision to turn back or divert will be easier if you have decided in advance what your personal minimum VFR flying altitude will be. That minimum altitude may well be much more conservative than the legal requirement.

A 'personal minimums' checklist, included in the CASA publication '*Flight Planning – always thinking ahead*', will help you control and manage risk by identifying risk factors and allowing you to fly with less stress and less risk.



Wreckage of the Cessna 206 aircraft

Source: ATSB

## Hostile environment

Investigation AO-2008-063

In September 2008, a Cessna 206 aircraft departed Bankstown, NSW on a private flight to Archerfield, Queensland via Scone, NSW. The private pilot had purchased the aircraft on the morning of the accident flight and it was reported that he was advised to track along the coast to Archerfield to avoid any weather problems. However, the pilot indicated his intent to visit friends in Scone.

The aircraft landed at Scone Airport and was met by the friends of the pilot, who observed the subsequent takeoff, in what was described by another pilot as 'poor weather'. The aircraft was reported missing when it did not arrive at its planned destination and the following day the wreckage of the aircraft was located on top of a ridge in rugged terrain, approximately 56 km north-north-east of Scone Airport. The pilot and his two passengers were fatally injured and the aircraft was destroyed.

The subsequent investigation concluded that the pilot was probably attempting to return to Scone after encountering weather unsuitable for flight under the visual flight rules and that the circumstances of the accident were consistent with controlled flight into terrain after encountering IMC.

It was determined that both the forecast and actual weather conditions were not suitable for VFR flight on the planned route, with low cloud, rain showers and high winds. The pilot most probably did not check the forecast weather before the flight. The route chosen for the flight was not suitable for the aircraft in the prevailing weather conditions.

### Lessons learnt

*Although the pilot would have been generally aware of the weather situation from observations during the flight from Bankstown, and at Scone itself, without knowledge of the forecast weather on the route selected it is unlikely that adequate consideration was given to the risks inherent in continuing the flight.*

*Attempting continued VFR flight when the weather clearly does not support it compromises the safety of yourself and your passengers. Running out of altitude and/or visibility leaves you without alternatives.*

# Calming influence

Investigation AO-2007-014

In June 2007, a Cessna Caravan float plane departed Broome Airport, Western Australia (WA) on a VFR charter flight to Talbot Bay, WA. On board the aircraft were the pilot and 10 passengers.

About 40 minutes into the flight, the weather conditions deteriorated and the pilot elected to return to Broome. During the return, the aircraft entered an area of reduced in-flight visibility that resulted in the loss of the visual horizon and, while manoeuvring the aircraft to regain VMC, the pilot became disoriented. The pilot made a general radio broadcast requesting assistance, which was received by the crew of another aircraft who initially advised the pilot of the Caravan to concentrate on maintaining the aircraft's orientation using its attitude indicator. After confirming that the Caravan pilot was maintaining the aircraft's attitude with reference to its instruments, the assisting pilot advised him to set cruise power, and to maintain level flight with reference to the vertical speed indicator.

The crew of the assisting aircraft reported that, about 5 minutes after the initial radio contact, 'the pilot of the aircraft sounded less stressed and advised us he was in level flight'. The pilot was able to regain control of the aircraft and, shortly after, resume the flight to Broome, which required the non-instrument-rated pilot to descend through cloud before becoming visual and landing.

## Lessons learnt

*The potentially severe consequences of this occurrence were probably avoided by the pilot's decision to seek assistance and the ability of the flight crew of the other aircraft to provide appropriate input and guidance. If you find yourself in marginal weather and becoming disoriented or lost, seek whatever help is available. Air Traffic Services may be able to provide assistance, especially if you are in radar coverage.*

*When caught in deteriorating weather, many pilots will descend to remain in VMC. Apart from the terrain hazards, descending may eliminate radar and communication contact. In order to get the aircraft safely on the ground it is up to the pilot to keep the aircraft under control. Being able to make a 180° turn, and if necessary climb to a safe altitude, requires proficiency at basic flying manoeuvres on instruments. Those skills, learned while training for the Private Pilot Licence, disappear if not regularly practised.*



# Conclusion

It should be noted that pilot decision making, particularly weather-related decision making, is complex and there is no single solution to the problem of VFR into IMC occurrences. However, there are a number of measures which can be used to reduce the significant risk inherent in the operation of VFR into IMC.

The ATSB Report *Improving the odds: Trends in fatal and non-fatal accidents in private flying operations*, found that problems with pilots' assessing and planning were contributing factors in about half of all fatal accidents in private operations. The report encourages all pilots to consider the following strategies to 'improve the odds':

- » make decisions before the flight
- » continually assess the flight conditions (particularly weather conditions)
- » evaluate the effectiveness of their plans
- » set personal minimums
- » assess their fitness to fly
- » set passenger expectations by making safety the primary goal
- » seek local knowledge of the route and destination as part of their pre-flight planning.

Also, becoming familiar with the aircraft's systems, controls and limitations may alleviate poor aircraft handling during non-normal flight conditions. Finally, pilots need to be vigilant about following rules and regulations that are in place – they are there to prevent errors being made before and during flight. Violating these regulations only removes these 'safety buffers'.

The Civil Aviation Safety Authority has produced media discs to address weather-related decision making. *Weatherwise* is an interactive presentation to enhance the ability of pilots to identify hazardous weather conditions. The *Weather to Fly* disc features interviews with senior pilots and human factors experts, and in-flight footage of specific locations. Some of the points covered are:

- » pre-flight preparation is important
- » obtain all the available weather information and update it regularly
- » make decisions early – when in doubt, turn about
- » VFR into IMC usually occurs in the last half of the flight
- » above all, do not close the back or side door (i.e. always leave an 'out')
- » talk to Air Traffic Control if possible
- » slow the aircraft down in precautionary mode to give more time and reduce the radius of turn
- » experience of marginal weather with an instructor is valuable
- » learn from mistakes (our own and others').

## Further reading and resources

The Civil Aviation Safety Authority (CASA) produces a wide range of safety materials designed to assist VFR pilots; including:

- » *Look out! Situational Awareness* — an informative DVD on situational awareness and why it's vital to flying safety.
- » *Weather to Fly* — revised 2011. This DVD highlights the dangers of flying in cloud, and how to avoid VFR into IMC.
- » *Flight Planning* — *always thinking ahead*. A flight planning guide designed to help you in planning and conducting your flight. Includes a 'personal minimums' checklist.

Additionally, CASA has an ongoing Safety Seminar Program targeting pilots in regional Australia and run in partnership with local aero clubs. VFR operations into IMC, situational awareness and decision making are just some of the safety issues covered.

Information on the Safety Seminar Program and for obtaining safety materials is available on the CASA website [www.casa.gov.au](http://www.casa.gov.au)

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