SERIOUS INCIDENT

Aircraft Type and Registration:	Reims Cessna F406, G-RVLY
No & Type of Engines:	2 Pratt & Whitney Canada PT6A-112 turboprop engines
Year of Manufacture:	1988 (Serial no: F406-0034)
Date & Time (UTC):	23 November 2022 at 0656 hrs
Location:	8 nm southwest of Isle of Man Airport
Type of Flight:	Commercial Air Transport (Cargo)
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	3,068 hours (of which 516 were on type) Last 90 days - 63 hours Last 28 days - 25 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

Whilst descending towards the Isle of Man the aircraft encountered severe turbulence which resulted in significant uncontrolled climbs and descents. The aircraft descended to 1,200 ft above the ground before the pilot was able to regain control and climb away.

Isolated severe turbulence was forecast in the area. This information did not preclude the flight or the start of an approach.

History of the flight

The pilot was operating a cargo flight from East Midlands Airport to Isle of Man Airport and was scheduled to land at approximately 0700 hrs. An occluded front was forecast to pass the Isle of Man around this time. The climb and cruise were uneventful with only light turbulence at FL100. During the cruise the pilot received the 0620 hrs Isle of Man ATIS indicating Runway 08 was in use, surface wind from 120° at 26 kt, visibility 7 km in rain, clouds few at 500 ft and broken at 700 ft, temperature 9°C and sea level pressure of 977 hPa[1].

Footnote

[1] The QNH changed to 976 hPa at 0639 hrs.

The pilot was cleared to descend to FL80 and then to 3,000 ft amsl. He recalled that the turbulence intensity increased in the descent. During the descent ATC gave the pilot an updated weather report with surface wind now from 140° at 30 kt and visibility 3,000 m in heavy rain. As the aircraft approached 3,000 ft the pilot reported that the autopilot was struggling with the turbulence and was making large control inputs. At 3,000 ft the autopilot disengaged, and the pilot took manual control. However, as he routed to the south of the airport, the turbulence intensity increased to the point that he was struggling to remain within 300 ft of the cleared altitude. At 0656 hrs the pilot told ATC it was "rough as hell" and ATC offered climb or descent. The pilot asked to climb and was cleared to climb to FL60.

Radar showed the aircraft at 2,400 ft amsl when the cleared altitude was 3,000 ft. The controller saw the aircraft leave its assigned heading and start a turn to the right and could see large variations in altitude with a descending trend. The pilot recalled that he was experiencing negative g and remembered seeing the vertical speed indicator rapidly changing between 3,000 fpm climb and 3,000 fpm descent. At 0658 hrs the pilot told ATC he was "really struggling" and ATC replied that he could take "any heading you like". The pilot reported that the airspeed was not fluctuating much but the stall warning was sounding intermittently. At one point there was a marked wing drop and the controls became "sloppy" so the pilot flew a stall recovery.

The aircraft reached a minimum altitude of 1,200 ft amsl approximately 2 nm to the south south-west of the airport. Shortly afterwards, at approximately 0700 hrs, the pilot reported that he was now able to maintain a climb. By this point, the aircraft was flying away from the airport. It was in IMC throughout the incident.

ATC asked the pilot if he would like to make a second approach or divert, and the pilot decided to divert back to East Midlands Airport. The return flight was uneventful. After landing the aircraft was inspected but no damage was found.

The pilot reported that during the turbulence encounter he experienced tunnel vision, which he thought was due to the g forces he encountered. He said he was "fighting it" through the encounter "one moment pulling then pushed the next" and was struggling to complete a full recovery process between the oscillations. However, he felt the UPRT[2] training he had received helped him fly the aircraft safely out of situation.

Recorded information

A recording of the radio transmissions between the pilot and Isle of Man ATC was obtained and used to confirm the history of flight.

Figure 1 was created from radar data and shows the altitude variation as the pilot flew through the turbulence.

Footnote

[2] UPRT - upset prevention and recovery training – the objective of which is to understand how to cope with the physiological and psychological aspects of dynamic upsets in aeroplanes; and to develop the necessary competence and resilience to be able to apply appropriate recovery techniques during upsets.

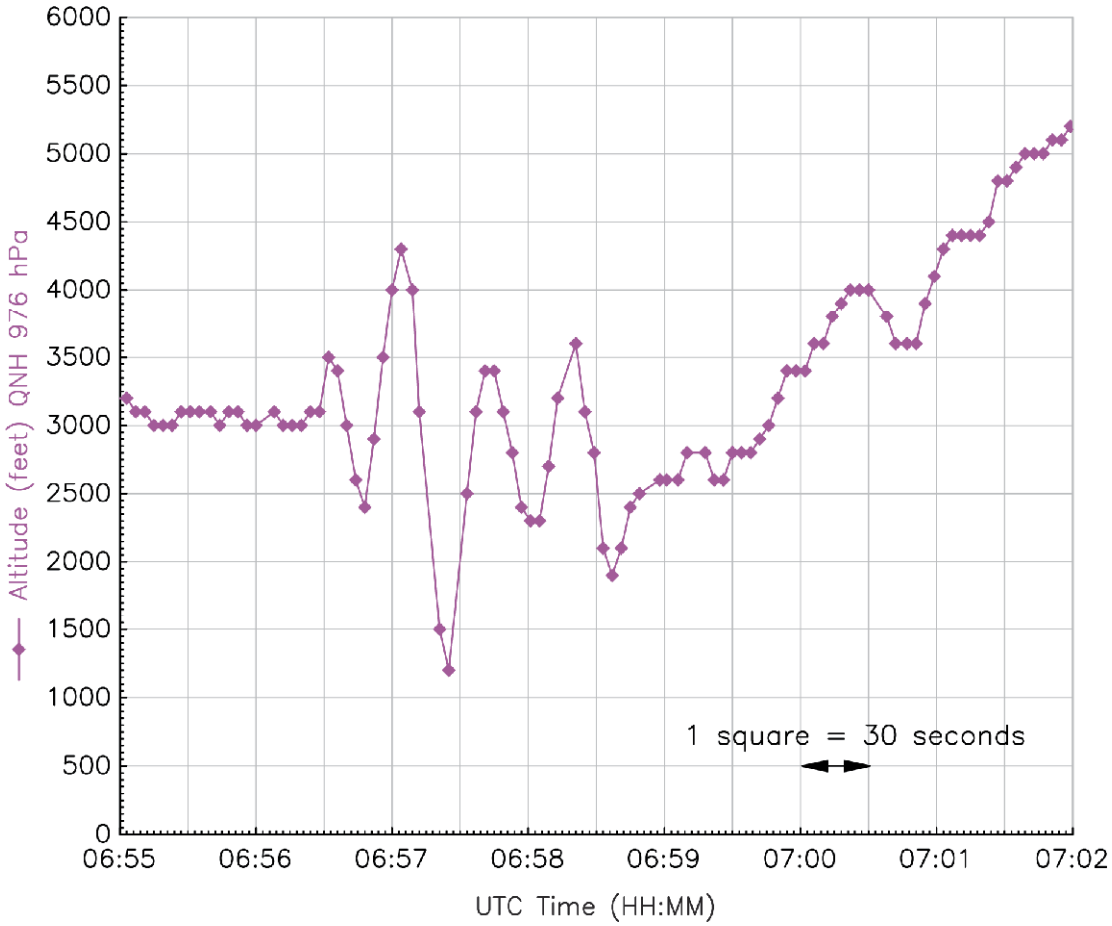


Figure 1

Plot of altitude variation from radar data during the turbulence encounter.

Aircraft information

The Reims Cessna F406 Caravan II (F406) is a twin turboprop aircraft with a maximum takeoff weight of 4,468 kg. The aircraft was not fitted with weather radar or any windshear detection equipment.

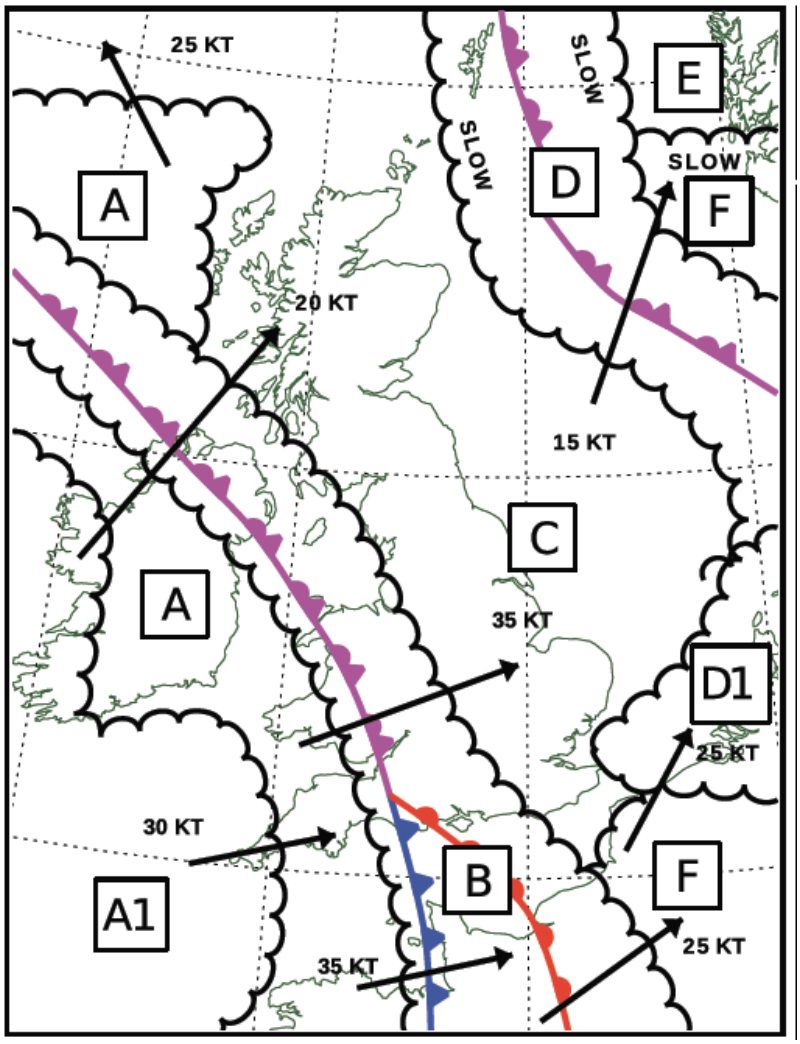
Meteorology

Forecast

The pilot received a briefing pack before the flight which contained METARs and TAFs relevant to the route, and the Met Office F215 and F214 together with other flight planning information. The pack contained the following forecast information for the Isle of Man:

TAF 230500Z 2306/2315 13025G37KT 7000 RA FEW005 SCT008 BKN015
BECMG 2306/2309 24022KT 9999 NSW FEW008 SCT020
TEMPO 2306/2308 4000 +RA BKN005 PROB30
TEMPO 2309/2315 7000 SHRA
BECMG 2309/2312 21018KT

Figure 2 shows the Met Office Form 215 which was included in the briefing pack. The chart shows the occluded front tracking across the Irish Sea. The Isle of Man is in Area B. The forecast suggests there would be isolated heavy rain squalls with visibility reduced to 1,200 m, and occasional moderate turbulence and isolated severe turbulence associated with the cold front and occlusion.



AREA	SURFACE VIS AND WX	CLOUD	0 C
B	20 KM NIL/-RA WDSPR 7 KM RA/-RADZ ISOL (OCNL FRONTS) 3000 M +RA/RADZ ISOL 1200 +RA SQ OCCLUSION AND ... ... COLD FRONT OCNL ∧ (ISOL ⅄ OCCLUSION AND ... .. COLD FRONT) OCNL HILL FG	BKN/OVC AC AS ⅄ ∧ 070 / XXX BKN/OVC CU SC ⅄ ∧ 015-025 / 070 OCNL SCT/BKN ST 007-012 / 015 ... ... (LCA 003-005 WARM FRONT AND ... ... WARM SECTOR)	040-050 N 050-070 S

Figure 2

Extract from the Met Office F215 valid on the 23 November between 0200 hrs and 1100 hrs (front positions valid at 0600 hrs)

Actual Weather

Table 1 shows the actual weather reports that were issued at Isle of Man Airport around the time the pilot experience the turbulence.

By 0729 hrs the wind had changed to 230° at 17 kt.

Figure 3 shows a radar image taken at 0630 hrs. The bright colours indicate significant precipitation along the frontal system.

Time	Wind	Visibility	Weather
0639 hrs	130° at 27 kt	3,000 m	Heavy Rain
0650 hrs	130° at 29 kt	7,000 m	Rain
0657 hrs	130° at 28 kt gusting 38 kt	7,000 m	Light Rain
0700 hrs	130° at 27 kt gusting 38 kt	6,000 m	Rain
0707 hrs	130° at 28 kt	4,000 m	Rain
0710 hrs	130° at 28 kt	4,000 m	Heavy Rain

Table 1

Extracts from the METARs and SPECIs[3] weather reports issued by Isle of Man Airport

Met Office review

The Met Office suggested that one indicator of a very active frontal system is the presence of a significant change in wind direction as the front passes. This windshear can result in severe turbulence being encountered, which is one of the reasons severe turbulence was forecast on the F215. The large directional change forecast and observed between 0600 hrs and 0900 hrs with relatively strong winds indicates there was likely to be severe turbulence.

The radar image (Figure 3) showed the rear edge of the rain band was very near to the Isle of Man at 0630 hrs. It shows some very bright colours in the area, as well as along most of the front, indicating heavier rainfall and a very active frontal system.

A CAA meteorologist advised that the inclusion of 'squalls' on the F215 was unusual and was an indication of the potential for significant turbulence. A squall is defined in CAP 746[4] as:

> *'A strong wind that rises suddenly: that is by at least 16 knots, increasing to 22 knots or more, and sustained for at least one minute, then dying away quickly; distinguished from a gust by its longer duration. A squall is associated with violent convective activity and the passage of active cold fronts. In the*

Footnote

[3] A SPECI is a type of METAR that is issued when there has been a significant change to the weather reported in the most recent METAR.

[4] CAP 746 - 'Meteorological Observations at Aerodromes', section 7.2.26, available at www.caa.co.uk [accessed March 2023].

latter case, typically squalls occur along the line of the front, accompanied by a veer in wind, a sharp fall in temperature, a rise in relative humidity and the appearance of a roll shaped cloud with a horizontal axis.'

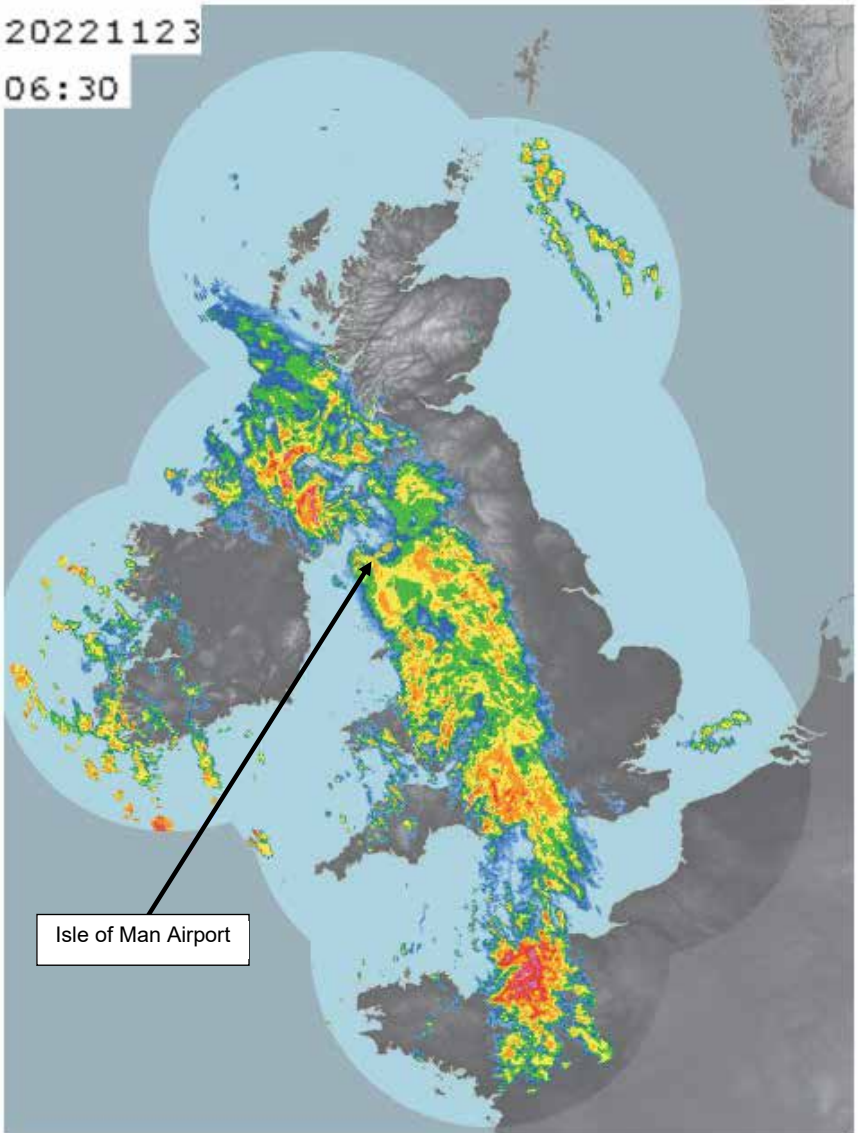


Figure 3

Weather radar image of the UK at 0630 hrs on 23 November 2022

Analysis

The aircraft encountered severe turbulence which resulted in an uncontrolled descent to 1,200 ft amsl before the pilot was able to regain control and climb away. The turbulence was caused by an occluded front passing through the area.

Information available to the pilot forecast isolated severe turbulence associated with the occluded front. However, as forecasts often cover a wide area and significant time band, it is not practical for commercial flights to avoid all areas where there may be severe turbulence.

The aircraft was not fitted with weather radar or windshear detection equipment to warn the pilot of the weather ahead and there were no reports of turbulence from other aircraft. The visibility, cloud base and wind were within the aircraft's landing limits, so did not preclude the pilot starting an approach.

The Met Office reported that the significant change in wind direction and strong winds which were forecast and observed were an indication that there was likely to be significant turbulence associated with the frontal system. A CAA meteorologist stated that the inclusion of squalls on the forecast was also an indication of a very active frontal system.

Pilots can contact the appropriate meteorological office to obtain clarification or amplifications of the forecast to assist their pre-flight planning. The Isle of Man has a dedicated forecast office. The phone numbers are provided in the AIP[5], Part 1, GEN 3.5 Meteorological Service, Paragraph 4.2.5. The AIP states:

> *'When necessary, the personal advice of a forecaster, or other meteorological information, can be obtained from the appropriate forecast office. Forecaster advice or other information for safety related clarification/amplification will only be given on the understanding that full use has already been made of available meteorological briefing material.'*

The pilot reported that the UPRT he had received helped him to successfully fly the aircraft through the turbulence.

Conclusion

The aircraft encountered severe turbulence which resulted in an uncontrolled descent. Isolated severe turbulence was forecast in the area, but this information did not preclude the flight or the start of an approach.

A review of the forecast by a meteorologist after the incident suggested there were some indications of the potential severity of the turbulence.

The AIP contains contact details for meteorological offices that may be able to provide pilots with additional forecast information before flight.

This serious incident demonstrates the benefits of UPRT for pilots.

Footnote

[5] Available at https://nats-uk.ead-it.com/cms-nats/opencms/en/Publications/AIP/ [accessed March 2023].