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pour la sécurité de l'aviation civile
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SAFETY INVESTIGATION REPORT

Accident to the ROBIN - DR400 - 500 registered F-HMYY on 5 August 2021 close to the Col du Glandon pass (Savoie)

Time	Around 14:50[1]
Operator	Aéroclub de Loire Atlantique
Type of flight	Cross-country
Persons on board	Pilot and three passengers
Consequences and damage	Pilot and two passengers fatally injured, one passenger seriously injured, aeroplane destroyed
This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.	

Collision with trees, fire, during a flight through a valley in a mountainous area

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on statements and the GNSS position recordings from the aeronautical application used by the pilot.

The pilot reserved the DR400-500 for a family sight-seeing cross-country flight of several days. On 1 August, with his partner, he took off from Nantes-Atlantique airport bound for Haguenau aerodrome to pick up their two children. On 3 August, they flew to Annecy (Haute-Savoie).

On 5 August, they took off at 14:22 bound for Sarlat (Dordogne). The pilot informed the controller that he intended to fly over lake Annecy before leaving the frequency at 14:28.

After flying over the lake, he followed the valley south and climbed to an approximate altitude of 3,700 ft. After passing Albertville, he continued southwards and took the valley towards Saint-Jean-de-Maurienne. His altitude decreased to 3,000 ft. After going past Saint-Rémy-de-Maurienne aerodrome, he turned south-west and took the valley leading to the Col du Glandon pass. On entering this valley (see *Figure 1* and *Figure 2*, point 3), the aeroplane was at an altitude of approximately 3,200 ft, i.e. a height of 1,500 ft.

[1] Except where otherwise indicated, the times in this report are in local time.

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November 2023 BEA2021-0376

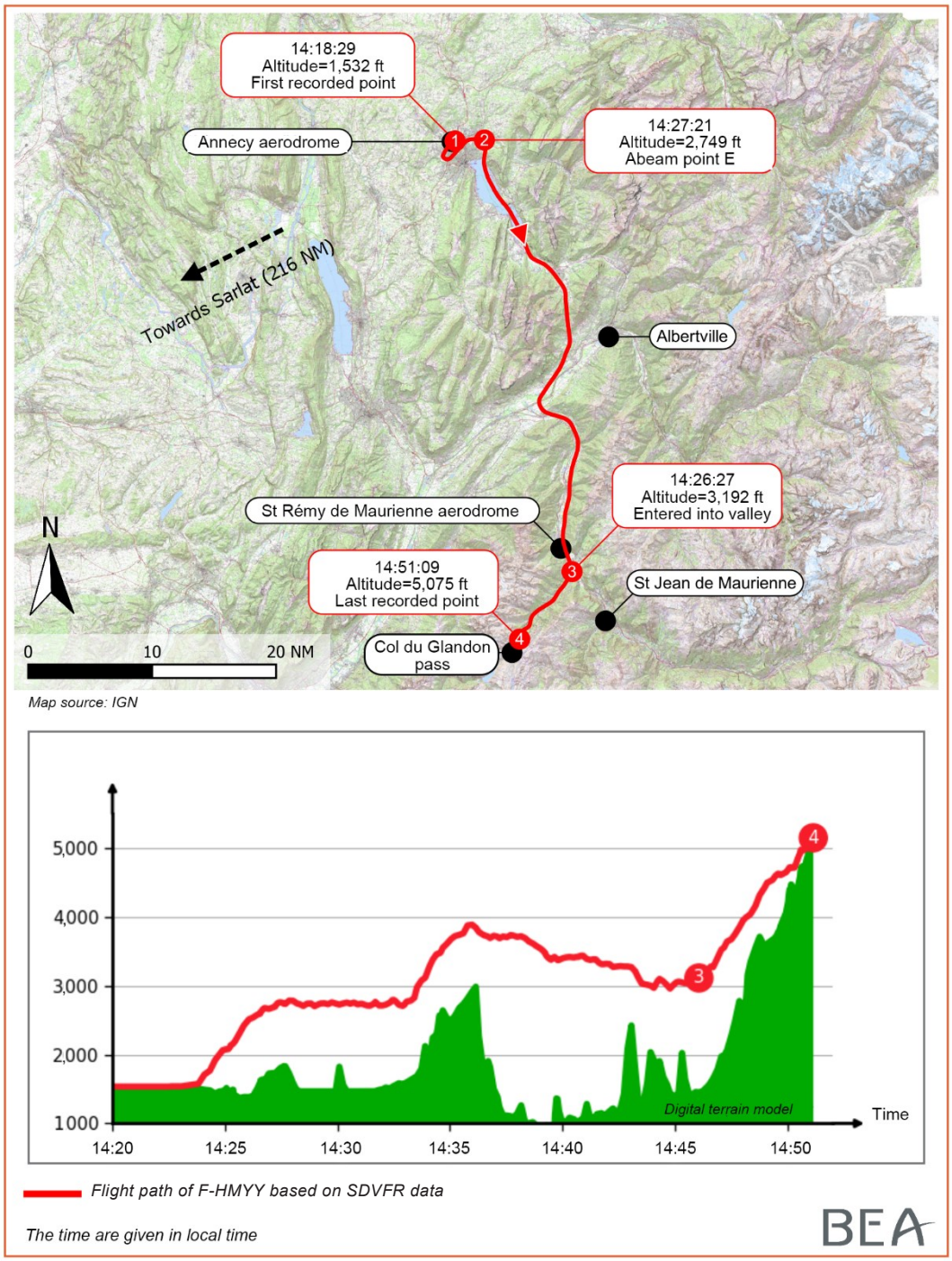

Figure 1: aeroplane's flight path

The pilot flew up the valley roughly following the road in the centre of the valley. The aeroplane climbed with a mean gradient of 5.1%[2] which is below the mean gradient of the valley. Although the aeroplane's altitude increased, its height progressively decreased because of the rising terrain.

[2] This gradient was calculated using the SDVFR application data recorded on the pilot's tablet.

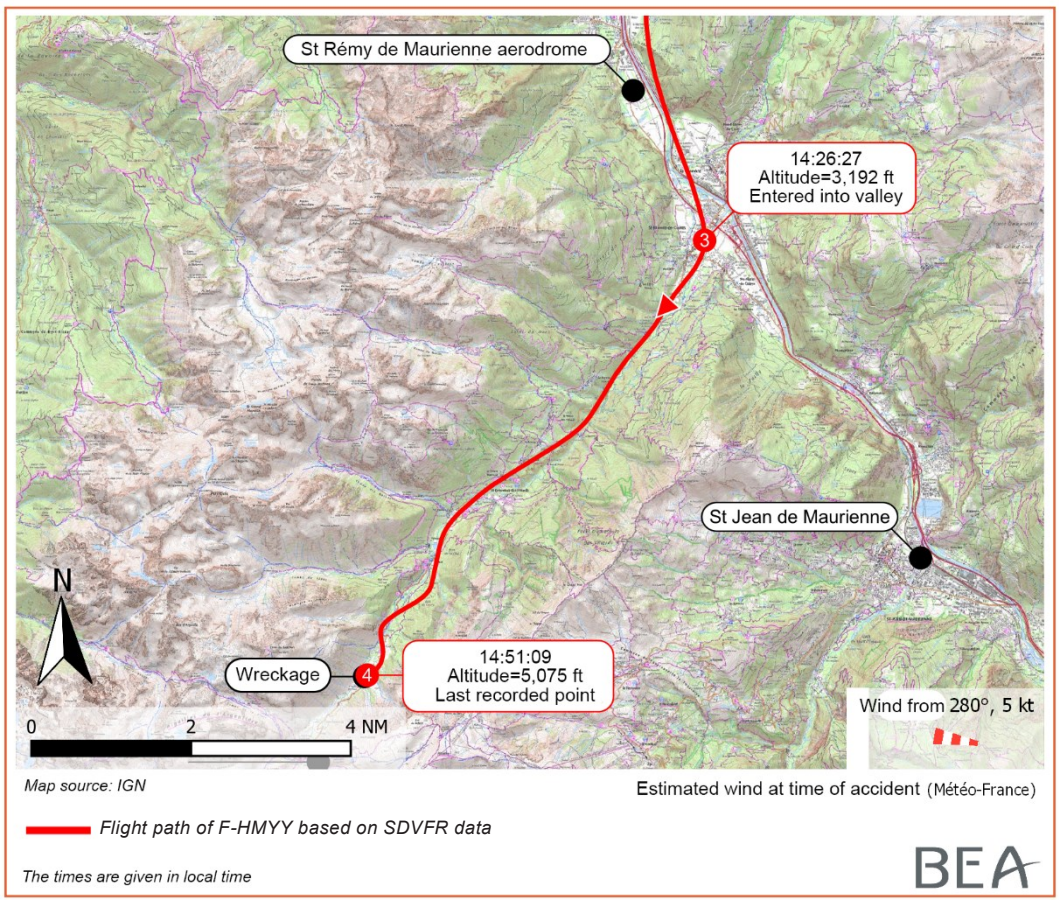

Figure 2: aeroplane's flight path in the valley leading to the Col du Glandon pass

Witnesses saw the aeroplane collide with trees, catch fire and then strike the ground. They helped the still conscious passenger, moving her away from the burning wreckage, but were unable to assist the other occupants.

2 ADDITIONAL INFORMATION

2.1 Site and wreckage information

The wreckage was situated at an altitude of 5,070 ft, around 2.4 km before the Col du Glandon pass, at the edge of the road leading to the pass.

The valley is roughly oriented 040°/220°. The mean gradient between the entrance to the valley and the site of the accident is around 8.4%. It then increases up to the pass.

Observations of the site and the wreckage indicate that the aircraft, coming from the north-east, struck the vegetation at a height of around eight metres, with its wings relatively flat, a roughly horizontal flight path and a significant horizontal speed.

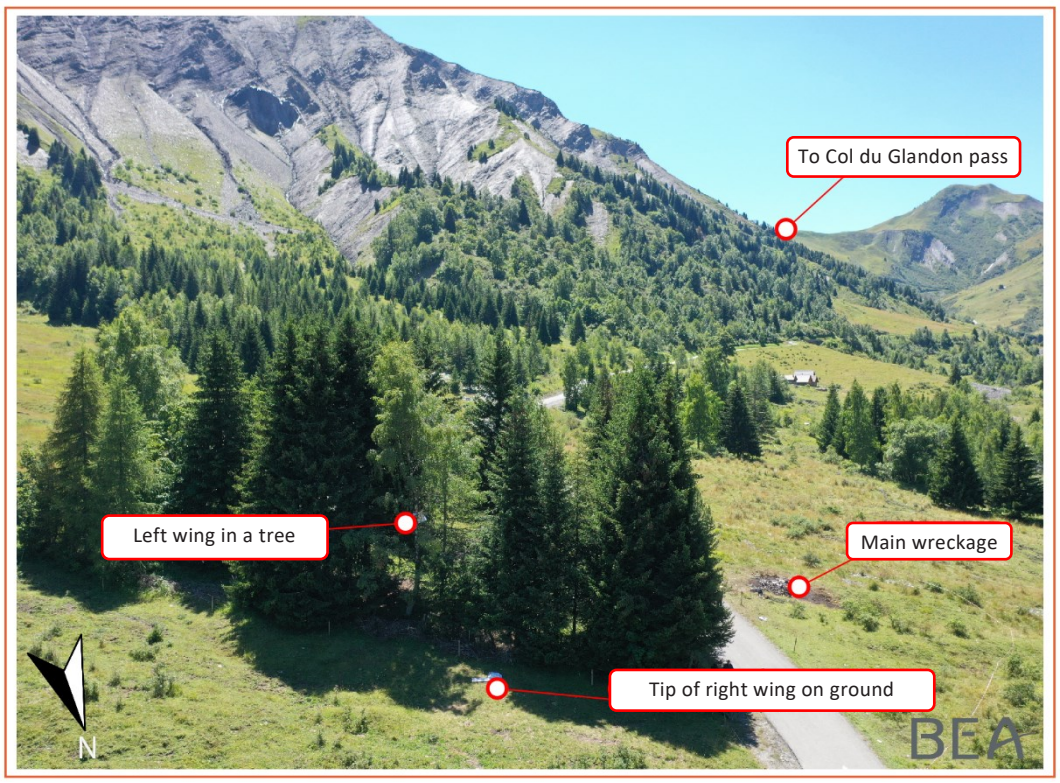

Figure 3: aerial view with drone (source: BEA)

The aeroplane was completely destroyed by the impact and the fire. The examination of the wreckage showed that at the time of impact with the vegetation, the flight controls were continuous on all three axes and the engine was delivering power. The continuity and position of the elevator and rudder trims could not be verified. The flaps were in the "retracted" position at the time of the accident. During the examination, no technical failure which could have contributed to the accident was identified.

2.2 Statements

2.2.1 Eyewitnesses in the valley

The following points emerge from the statements of several people located close to the road, who saw the plane flying up the valley towards the Col du Glandon pass:

- the aeroplane appeared to be flying up the valley, overhead the road in its centre;
- the aeroplane was flying at a low height, close to the tree tops;
- the flight path was stable and the aeroplane's wings were more or less horizontal;
- the engine could be heard and was emitting a regular noise;
- no smoke or anything unusual was observed prior to the collision with the trees.

2.2.2 Witnesses at Annecy

On the day of the accident, the pilot and his passengers arrived at Annecy airport at around 09:00. As the weather conditions were not favourable for visual flight, due to precipitation in particular, they waited in the terminal for the latter to stop. A witness indicated that the pilot did not seem stressed by the wait and remained calm.

The pilot topped up the tanks with 117 litres of fuel. The ARFF officer present at the time of refuelling indicated that the pilot put fuel in the two wing tanks and the main tank. He did not know whether these tanks had been completely filled or how much fuel they contained before refuelling. He added that the pilot was relaxed and did not seem tired.

The tower controller indicated that he did not notice anything unusual when F-HMYY took off.

2.3 Meteorological information

2.3.1 General conditions in the region of the occurrence

In the middle of the day, an influx of moist air preceded the low layers of the cold front. This gave rise to fairly dense altocumulus clouds in the afternoon, which could have caused a few drops over the higher ground. The French met office, Météo-France, estimated that the sky could have been very cloudy between an altitude of 3,000 ft and 6,000 ft throughout the region, but was unable to determine the precise cloud cover in the valleys, particularly those around Albertville and the Col du Glandon pass.

The investigation was not able to determine what meteorological information was gathered by the pilot in preparation for his flight.

2.3.2 Conditions at the accident site

The conditions estimated by Météo-France at the site of the accident was as follows:

- wind from 280° of 5 kt with gusts at 15 kt;
- few to scattered clouds in the valley;
- temperature 10 °C and dew point temperature 8 °C.

All the witnesses present in the valley at the time of the accident reported that the weather conditions were very good, being sunny with a few isolated clouds. They reported that the air was calm or that there were light winds. In a photo taken less than an hour after the accident, a portion of blue sky with a few isolated clouds can be seen.

2.4 Aircraft information

The DR400-500 registered F-HMYY was equipped with a Lycoming IO-360 engine providing a maximum power of 200 hp at 2,700 rpm, and a variable-pitch propeller. It had two wing fuel tanks each one of a capacity of 40 l, a main fuel tank of 105 l and an auxiliary fuel tank of 90 l. It was fitted with a two-axis autopilot and a Garmin GNS430 system[3].

The occupants of the aircraft had taken several pieces of baggage with them, as shown by video recordings from Annecy airport. Only two pieces of baggage were not burnt and were weighed. The weight and balance estimate was based on an estimation of the weights of the occupants, the baggage and the probable amount of fuel present at the time of the accident. The aeroplane was very probably close to the maximum weight and aft centre of gravity limit indicated in the manufacturer's flight manual.

[3] No flight data was recorded by this computer.

The theoretical maximum climb gradient of the aeroplane in the valley could not be determined using the information in the flight manual. The aeroplane manufacturer provided the BEA with measurements taken during test flights, which enabled this climb gradient to be estimated.

At the maximum authorised take-off weight and in the conditions prevailing on the day of the accident, the aeroplane's maximum climb gradient would have been approximately 8.5%, when flying at an indicated airspeed of between 130 and 135 km/h.

Note: the data recorded in the pilot's tablet did not permit a sufficiently accurate calculation of the indicated airspeed of F-HMYY when it was flying in the valley.

2.5 Application used by pilot

The pilot used the SDVFR application on his tablet during the flight. In addition to tracking the flight, this application can be used for flight preparation. During the investigation, it was not possible to determine whether the pilot had partly prepared his flight using this application.

Several base maps can be used. The commonly used ICAO SD map displays the topography of the terrain using a colour code (see *Figure 4*). Contour lines and the altitudes of peaks and passes are not shown.

Figure 4: screenshot of the SDVFR application on another tablet

For comparison, on the ICAO IGN map (see *Figure 5*), some terrain altitudes[4] are shown. On the IGN map (see *Figure 6*), the contour lines provide a better image of the topography. However, this type of map is difficult to use in flight.

[4] In mountainous regions, the elevation of isolated summits and the highest points of ridges are given. This is not the case for the passes.

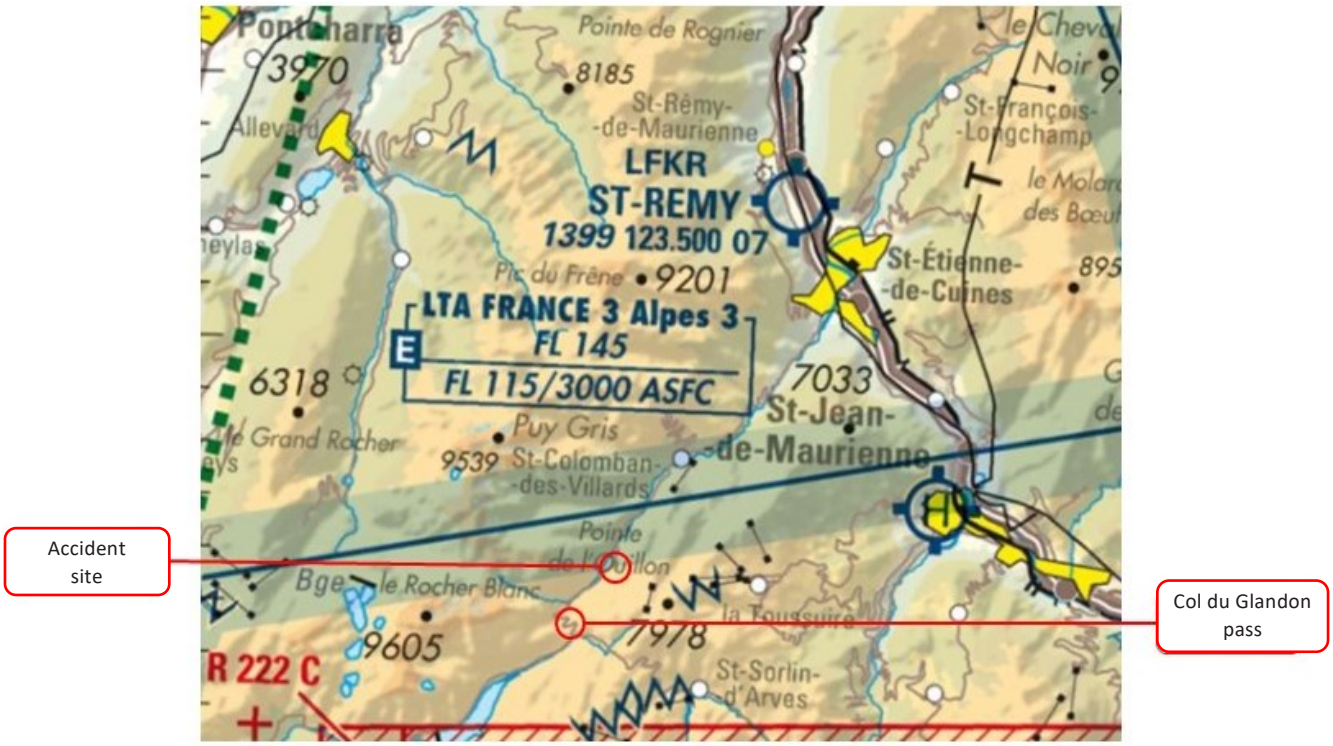

Figure 5: excerpts from OACI IGN map (source: Géoportail)

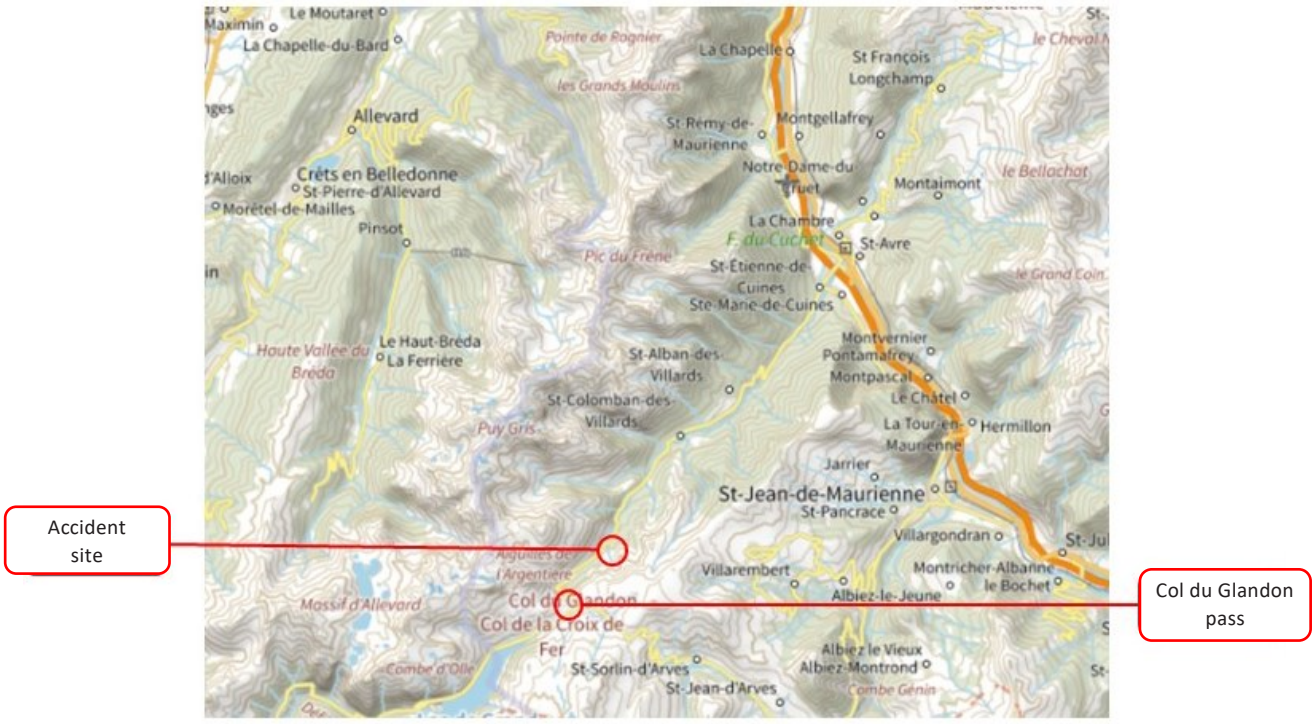

Figure 6: excerpt from IGN map (source: Géoportail)

2.6 Pilot information

The 51-year-old pilot held a private pilot licence issued in 2011 with a single engine piston rating and a class 2 medical certificate, all valid. His pilot log book was destroyed in the fire. Based on the information collected from the two clubs in which the pilot had flown, he had totalled around 230 flight hours.

The pilot joined the Aéroclub de Loire Atlantique in 2016. He carried out approximately 50 flight hours in the club, all on the DR400. According to the club's records, he flew just over ten hours in 2021, including a five-hour cross-country round trip and three flights lasting a total of two and a half hours in dual control on the F-HMYY, after which he was approved for the DR400-500.

The instructor who carried out the three familiarisation flights with the pilot on the DR400-500 said that the latter had had no particular difficulties and that he had quickly assimilated the differences with the other DR400s in the club, in particular the variable pitch propeller, the electric trim and flaps and the autopilot. He specified that he did not cover the functionalities of the GNS430.

The instructors at the flying club indicated that the pilot had had no particular difficulty. He was diligent and took into account the comments made to him. He was described as a "decision-maker" and having confidence, but was not considered to be a pilot who took risks. They specified that he was comfortable using IT tools and was used to using navigation applications.

The members of the flying club met during the investigation indicated that they were not aware of the pilot's plans, in particular his intention to fly in the mountains. The information gathered from the two flying clubs showed that the pilot most probably had no experience of flying in mountainous terrain.

2.7 Accidents during cross-country flights in mountainous terrain

In its review of reports published in 2021 and 2022, the BEA selected the safety topic, insufficient knowledge or experience for mountain flying. It stated that, "*Mountain flying has specificities due to the environment: unusual visual references due to the loss of the natural horizon, reduced operational performance, complex and changing aerological conditions and restricted space. Specific knowledge and skills are required to fly safely in this hostile and demanding environment.*"

In February 2023, the BEA published a report concerning two accidents[5] which occurred during a circular cross-country flight in a mountainous region undertaken by a group of around twenty aircraft. The two accident aeroplanes entered a valley at an insufficient height to clear the pass. One of the two pilots tried to land on tree tops while the second pilot aborted the flight and landed in a mountain pasture. Four of the five aircraft occupants were seriously injured.

3 CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation.

Scenario

After passing Albertville, the pilot took a southerly track that did not appear to be consistent with his intended destination. The investigation was not able to determine the reasons that led the pilot to head in this direction, and in particular whether it was intentional or not.

[5] https://bea.aero/en/investigation-reports/notified-events/detail/accident-to-the-cirrus-sr20-registered-d-efcd-on-22-08-2021-at-vars/

The pilot then entered the valley leading to the Col du Glandon pass and followed a direct track towards the pass. This direct flight path, given the aeroplane's performance and the altitude at which it entered the valley, did not leave the aeroplane sufficient time to gain the altitude required to cross the pass. As a result, although the aeroplane gained altitude, it gradually approached the ground and the slopes of the valley. Furthermore, flying in the centre of the valley, the pilot had only half the space available to perform a U-turn.

As the height decreased, it would have become increasingly difficult for a pilot without mountain flight experience, to manoeuvre in the absence of a natural horizon which was concealed by the high ground. The pilot thus continued on his path while getting closer and closer to the ground. The aeroplane struck obstacles around five minutes after entering the valley.

Contributing factors

The following factors may have contributed to the pilot following a direct flight path in the valley which would not allow the aeroplane to clear the pass:

- an underestimation of the risks inherent in flying in mountainous areas;
- insufficient knowledge of the specific flight techniques for mountainous areas and a very probable lack of experience of mountain flying;
- the possible mental picture of a direct flight path on the navigation application commonly used by the pilot, which has a display format which makes it difficult to visualize the topography of a valley.

Safety lessons

In 2022, the French Aeronautical Federation (FFA) published a practical guide concerning plain pilots and mountain flying, Pilote de plaine et vol en montagne, in order to raise awareness amongst pilots, about the main dangers inherent in mountain flying. In particular, it indicates that:

- As the mountain is a confined environment, this very quickly limits the manoeuvring possibilities of light aircraft, both vertically and horizontally. Furthermore, as a result of the increase in altitude, the performance of non-turbo engines often decreases much more rapidly and to a greater extent than plain pilots realise.
- Similarly, mountain valleys become progressively narrower in width from downstream to upstream, while the slope of the terrain increases steadily. This natural funnel-shaped configuration can quickly prevent an untrained pilot from making a U-turn in the event of a problem or necessity.

In June 2022, the FFA also published a practical guide concerning climb performance and mountain flying, Performances de montée & vol en montagne. It specifies that mountain flying cannot be improvised and that specific training is absolutely essential.

The BEA investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liabilities.