



Accident to the FLIGHT DESIGN – CTLS-ELA registered F-HVAT

on 18 June 2021

at Col des Prés, in the commune of Thoiry (Savoie)

⁽¹⁾ Except where otherwise indicated, times in this report are local.

⁽²⁾ Alpes Aéro is a DGAC-approved training organisation (ATO).

Time	Around 19:10 ⁽¹⁾
Operator	Alpes Aéro ⁽²⁾
Type of flight	Cross-country instruction flight
Persons on board	Instructor and student-pilot
Consequences and damage	Instructor and student-pilot fatally injured, aeroplane destroyed

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in June 2022. As accurate as the translation may be, the original text in French is the work of reference.

Attempted turn-around before flying over a pass, collision with trees then with the ground, fire, in instruction

1 - HISTORY OF THE FLIGHT

Note: the following information is principally based on statements, radio communication recordings, a camera installed at Chambéry - Challes-les-Eaux aerodrome, as well as radar data. This radar data only covers some of the outbound leg, mainly when the aeroplane was flying over the plain and does not cover the last part of the flight leading up to the accident.

The student-pilot, accompanied by an instructor, took off at 18:27 (see [Figure 1](#)) from Annecy-Meythet aerodrome (Haute-Savoie). After two aerodrome circuits, including one at low height, the instructor announced to the air traffic controller their intention to head towards Chambéry - Challes-les-Eaux aerodrome (Savoie) passing via ALBY⁽³⁾ (see [Figure 1](#)) and to return approximately 45 minutes later.

A security camera at Chambéry - Challes-les-Eaux aerodrome recorded the landing of the aeroplane on runway 32 at 18:56. Two minutes later, the camera recorded the aeroplane taxiing on the Bravo taxiway to runway 32, followed by a take-off at 19:00 (see [Figure 1](#)).

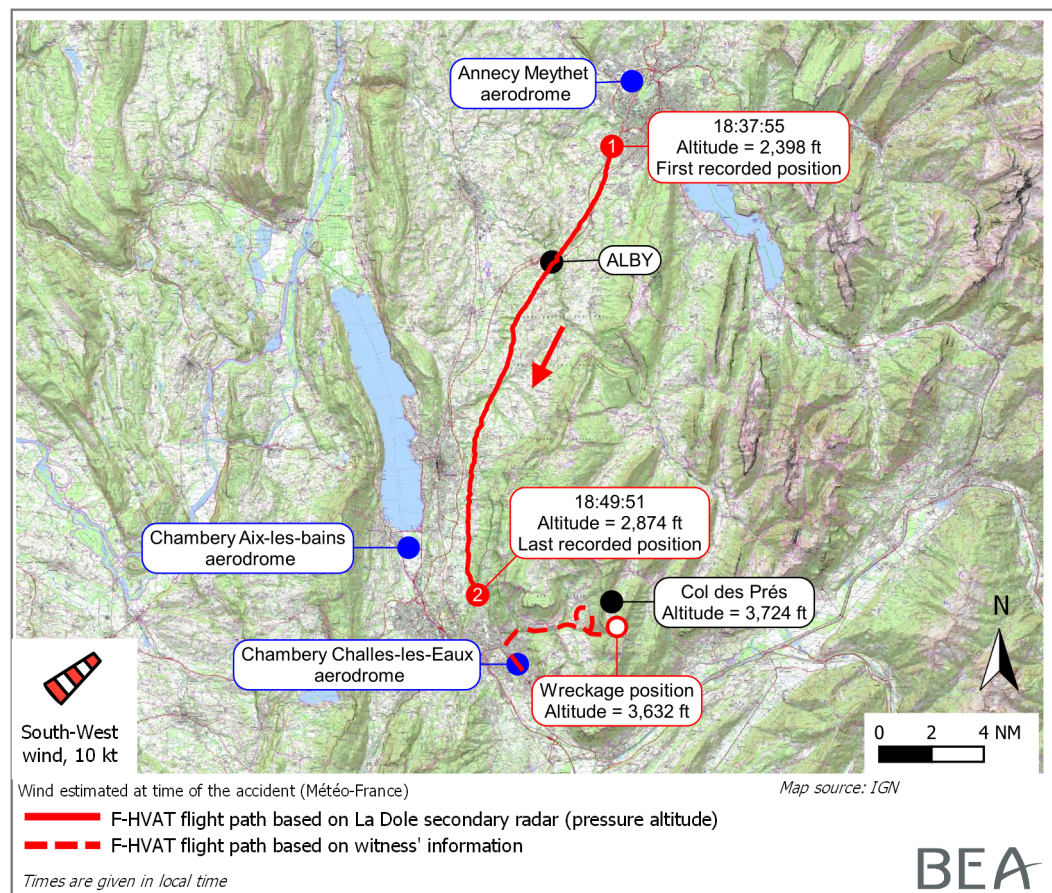
Shortly after 19:00, a witness who lived at Saint-Jean-d'Arvey (Savoie) saw an aeroplane coming from the direction of Chambéry - Challes-les-Eaux and heading towards Col des Prés pass in the Bauges Mountains. He saw the aeroplane make a full left turn in the vicinity of the commune of Thoiry before heading back towards the pass (see [Figure 2](#)). He thought that the aeroplane had been lower than he was used to seeing. He specified that he had not seen any other aeroplanes at around 19:00.

⁽³⁾ VFR reporting point.

Shortly after 19:00, several groups of witnesses who were in the vicinity of Col des Prés pass (see [Figure 3](#)) saw the aeroplane flying low, at a height of several tens of metres above the trees in the centre of the valley and heading towards Col des Prés pass. A witness who had been driving her car down the pass towards Chambéry saw the aeroplane make a right turn at low height. The different witnesses all stated that a few seconds after they had seen the aeroplane fly past, they heard a loud noise and then saw smoke.

At 19:11, the rescue services received a signal from the aeroplane's emergency locator transmitter.

At 19:40, the wreckage of the aeroplane, which was on fire, was located by the rescue services.



Source: BEA

Figure 1: flight path of the aeroplane

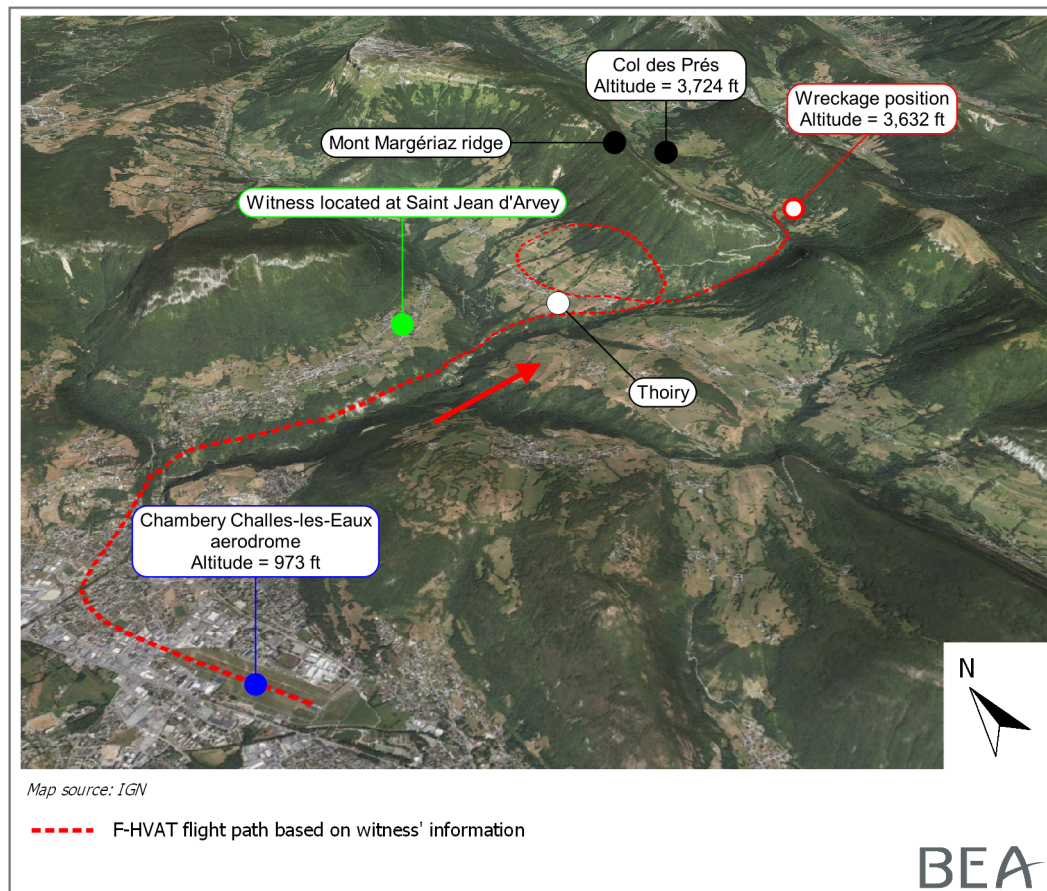


Figure 2: final path of the flight according to the statements

2 - ADDITIONAL INFORMATION

2.1 Site and wreckage information

The wreckage was located in an area of pastures, at an altitude of 3,632 ft (approximately 1,100 m), around 1.5 km below Col des Prés pass which is at an altitude of 3,724 ft (approximately 1,135 m). Due to the vegetation, the area is not really suitable for a forced landing (see [Figure 3](#)). The bottom of the valley from Thoiry towards Col des Prés pass has an upward slope of approximately 6 to 9%.

The aeroplane was completely destroyed in the fire that broke out after impact.

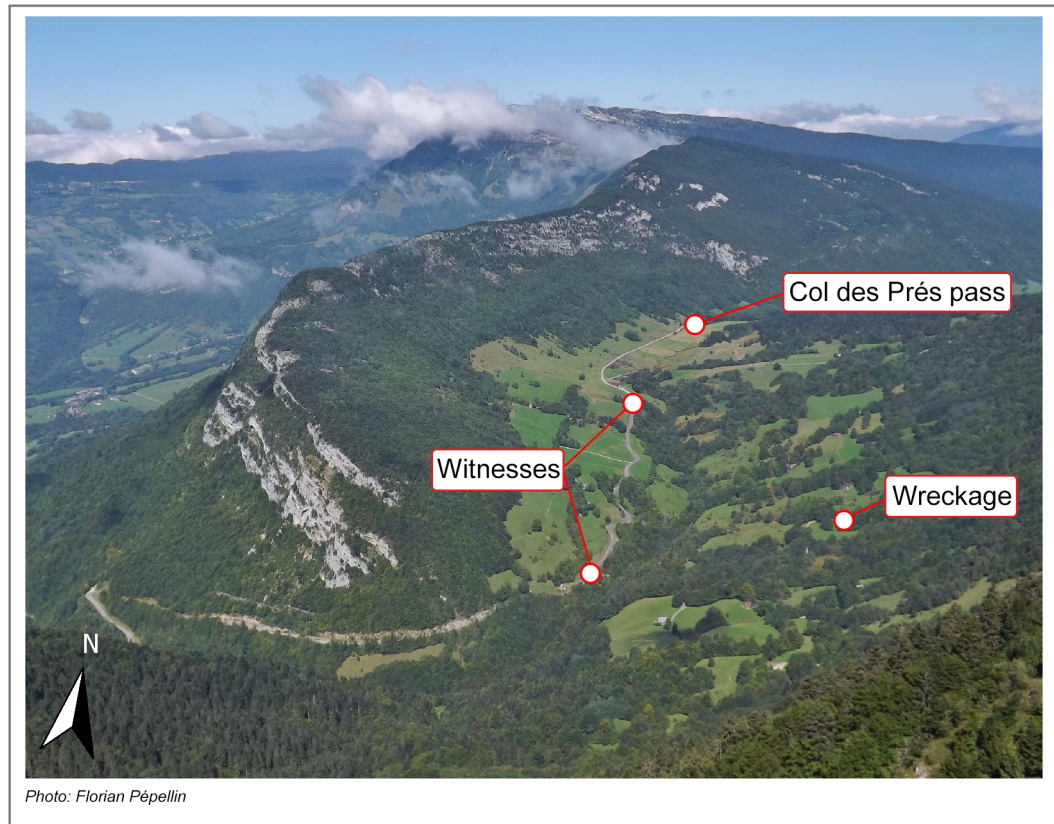


Photo credit: Florian Pépellin

Figure 3: view of Col des Prés pass and location of the wreckage

The examination of the site and marks in the vegetation indicated that the right wing had very likely struck trees during a right turn (see Figure 4). The aeroplane turned over on contact with the vegetation and before collision with the ground.

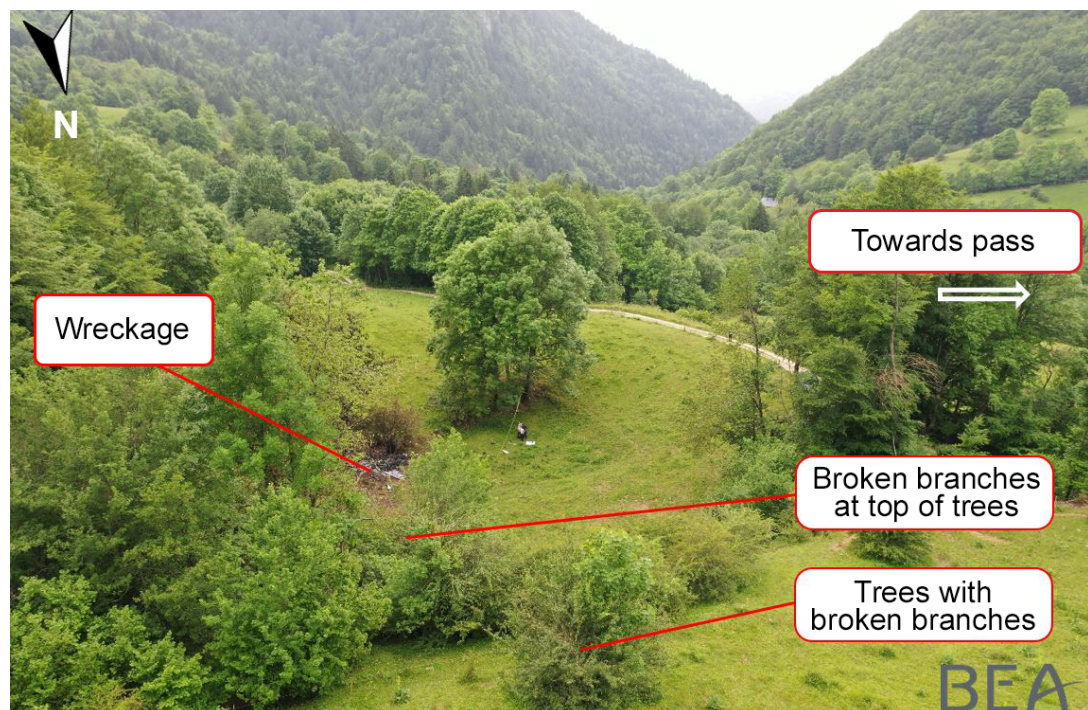


Figure 4: accident site

The rudder and the central part of the elevator, not identified, were very probably destroyed by the fire. However, observations made on the wreckage showed that the elevator and rudder control linkages were probably continuous at the time of impact. The continuity of the aileron control and the flaps could not be checked fully due to the damage caused by the fire. The position of the flaps could not be determined.

The three propeller blades were broken at their base. They were found in the vegetation, in the vicinity of the wreckage. The engine was found burnt and was not taken for further examination due to the damage caused by the fire. The damage observed on the blades and scattered debris indicated that the engine had been operating at the time of impact. The amount of torque being transmitted by the engine could not be determined.

The airframe parachute as well as its ballistic release system were destroyed due to the fire. The parachute had not been activated before the impact with the ground.

The examination of the wreckage did not reveal any element that may have contributed to the accident.

Several aeroplane computers and mobile phones belonging to the occupants were found at the site and examined at the BEA's premises. Due to the extensive damage caused principally by the fire, no data could be retrieved from any of the devices taken for examination.

2.2 Meteorological information

On the day of the accident, the weather conditions were suitable for a VFR flight. According to Météo-France:

- There was a southwesterly wind of around 10 kt in the flight area.
- Convective clouds may have been present in the vicinity of the high terrain and may have caused strong gusts of wind in the vicinity of the convective cells with downdrafts downwind of the terrain.
- The QNH was 1014 hPa at Chambéry - Aix-les-Bains and 1016 hPa at Annecy-Meythet.
- Visibility was greater than 10 km, the temperature in the valleys was 31°C at an altitude of around 1,000 ft (approximately 300 m) and 23°C at 3,600 ft (1,100 m)⁽⁴⁾. A yellow heatwave warning had been issued for the department of Savoie.

In the afternoon of the accident, glider pilots were flying over the western slope of Margériaz ridge, on the other side of the ridge with respect to Col des Prés pass (see [Figure 3](#)). According to their statements, the wind, calm at ground level, picked up at around 1,200 m blowing from the south west. They specified that the gliders had been climbing very steeply with a rate of climb of approximately 3-4 m/s. They estimated that there would have been downdrafts on the eastern slope (corresponding to the valley leading to Col des Prés pass), downwind of the terrain.

Several aeroplane and glider pilots from the region stated that flying over Col des Prés pass with a southerly or southwesterly wind could be treacherous, that turbulence and downdrafts could be present in these conditions and that it was preferable to fly over it with sufficient safety margins in terms of altitude.

At around 19:00 on the day of the accident, a section of the western slope of the valley of Col des Prés pass was in shadow. An aerial photograph taken by a rescue helicopter at around 20:00 showed that the wreckage was on the sun/shade boundary.

⁽⁴⁾The density altitude (pressure altitude corrected based on temperature variations) at the accident site was therefore around 5,400 ft.

⁽⁵⁾ Light Sport Aircraft (single-seater or two-seater, non-pressurised aeroplane with piston engine, maximum weight less than or equal to 600 kg).

2.3 Aeroplane information

The aeroplane was a Flight Design CTLS-ELA, two-seater LSA⁽⁵⁾-certified aeroplane, powered by a 100 hp naturally-aspirated injection engine (ROTAX 912 iSc2 SPORT) and equipped with a Neuform CR3-65-47-101.6 three-blade propeller whose pitch could be adjusted on the ground. Its structure was made mainly from composite materials. It was equipped with an airframe emergency parachute.

At the time of the accident, the engine had logged 213 h and the airframe had logged 155 h. The last scheduled maintenance inspection (100-h inspection) had been carried out on 10 June 2021, when the airframe had logged 150 h.

One week before the accident, the aeroplane engine had experienced temporary overheating during an instruction flight. The instructor specified that the aeroplane had been in full sun in the parking area since its last flight in the morning and that the outside temperature had been around 30 °C.

An unscheduled maintenance operation had been carried out after the flight. During the three flight hours flown between this maintenance operation and the accident, no engine operating anomaly had been observed.

Note: during the accident flight, it is very likely that if any engine overheating had occurred before the aeroplane entered the valley, the pilots would have turned around to avoid entering the valley.

The estimated weight of the aeroplane at take-off from Annecy was close to the maximum permissible weight, but within the limits defined by the manufacturer. The balance was also compliant with the standards.

2.4 Pilot information

2.4.1 Instructor

Experience and licence

The 43-year-old instructor held a Commercial Pilot Licence - Aeroplanes (CPL(A)) along with valid SEP, MEP, IR/SE and IR/ME ratings. He held a Flight Instructor - Aeroplane rating (FI(A)) issued in 2011 and a Type Rating Instructor in complex HPA aeroplanes (TRI(SPA)) issued in 2017. He held a EMB500/505 type rating (Embraer Phenom 100 and 300). He also held a microlight pilot licence.

Between 2002 and 2008 he held a glider pilot licence. He flew for several years at the Centre Savoyard de Vol à Voile Alpin at Chambéry - Challes-les-Eaux. He had also paraglided in the region.

He held a mountain wheel rating from 2017 to 2020 that had not been revalidated. According to the statements, he was one of the most experienced instructors at Alpes Aéro for flying in mountainous areas. He was not a "mountain" flight instructor.

Moreover, he had held the position of chief instructor⁽⁶⁾ at Alpes Aéro (CFI) since the creation of the ATO in June 2020.

⁽⁶⁾ Alpes Aéro employed four instructors.

According to his log book:

- ❑ He had logged more than 3,400 aeroplane flight hours.
- ❑ He had logged 75 flight hours in the previous three months:
 - the majority (58 flight hours) of which as pilot on a twin-engine jet aircraft (Embraer Phenom 300 and Cessna Citation C525b);
 - 17 hours of which on a single-engine piston aeroplane (SR22, C170 or CTLS), all as local flights from Annecy-Meythet, from Chambéry - Aix-les-Bains or in cross-country flights to the plain, of which 14 hours as an instructor on the CTLS.
- ❑ The flights made in the last three months were fairly representative of all the flights recorded in the pilot's log book in the last few years, with most of the flights made in a twin-engine jet aircraft and a few flights made in a single-engine piston aeroplane, mainly in local instruction flight.
- ❑ The other main single-engine aeroplanes used by the pilot included a DA40 TDI (powered by a turbo-diesel engine) and a SR22 GTS (four or five-seater aeroplane equipped with a 310 hp naturally-aspirated engine).

Mountain experience

The study of his log book showed the following:

- ❑ He completed his mountain rating training at Chambéry - Challes-les-Eaux from May to June 2017, logging a total of 14 flight hours on the Jodel D113 (two-seater aeroplane equipped with a 100 hp naturally-aspirated engine generally used for mountain flying).
- ❑ Although they had not been recorded as mountain flights, around 10 other flights might have been in a mountainous area. These flights were made from Chambéry - Challes-les-Eaux on the Jodel D113 in the autumn of 2017 following his training.
- ❑ Three other flights were recorded as mountain flights between his training and the accident flight. These three flights were round-trip flights departing from Chambéry - Challes-les-Eaux aerodrome in the autumn of 2019 on the Jodel D113. No flights on the Jodel D113 were logged in his log book since this date.
- ❑ His last Chambéry - Challes-les-Eaux – Annecy-Meythet flight was on 10 May 2019 on the DA40 TDI (four-seater aeroplane equipped with a 135 hp turbo-diesel engine) and lasted around 35 minutes.

Flying habits and differences in aeroplane performance

The study of the instructor pilot's licences and log book brought to light that he had a lot of recent and overall aeronautical experience, mountain flying experience associated with his mountain wheel rating held from 2017 to 2020, as well as experience of flying in and knowledge of the accident area.

However, it also came to light that his recent mountain flying experience, with flight over a mountain pass for example, was probably minimal and that he had mainly flown in the days before the accident on high-performance twin-engine jet aircraft, on which the visual references substantially differ from those on the CTLS.

2.4.2 Student-pilot

The 22-year-old student-pilot had been training for his private pilot licence within the organisation since February 2021. He had logged approximately 13 flight hours with his last flight recorded on 20 May. He had only trained with the accident flight instructor.

The accident flight had been his first cross-country flight.

2.5 ATO's Procedures

The ATO's procedures require that the following elements are seen during the first cross-country flight bound for another aerodrome:

- flight preparation, departure briefing and taxiing;
- dead reckoning navigation from A to B;
- return flight based on navigation using natural or artificial references;
- use of navigation log and implementation of navigation characteristics;
- turning point procedure;
- joining a controlled or uncontrolled airfield.

The outbound leg of the accident flight to Challes-les-Eaux appeared to correspond to dead reckoning navigation and the return flight to navigating using natural or artificial references via Col des Prés mountain pass.

There is no specific procedure within the ATO concerning cross-country flights in the mountains and flying over mountain passes for students in PPL training.

2.6 Specificities of mountain flying

The additional mountain flying rating⁽⁷⁾ associated with the Private Pilot Licence - Aeroplanes accords pilots the right to land at or to take off from mountain airfields and mountain landing areas.

Flying in a mountainous area, in valleys or over passes is not however subject to a specific rating and can be performed by any pilot. However, it is necessary to take into account a number of specificities and best practices specific to this type of flight such as those listed below⁽⁸⁾:

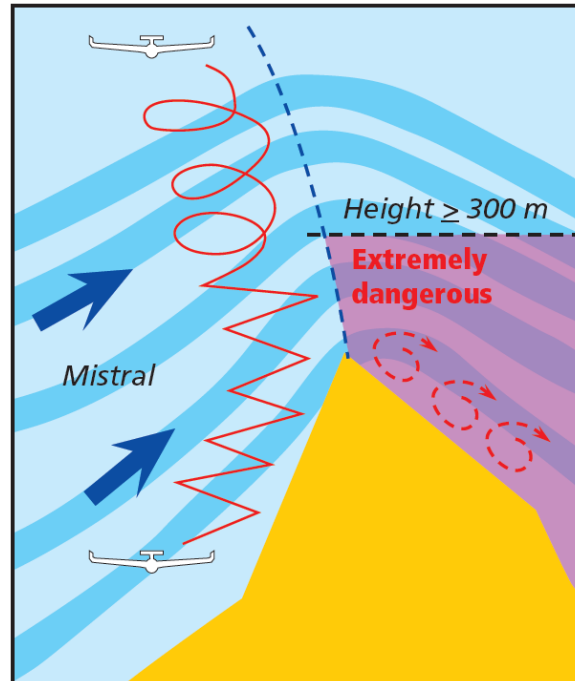
- A non-turbocharged engine equipping a light aeroplane loses approximately 10% of its maximum power per 1,000 m altitude band, as the amount of available oxygen in the air for fuel combustion decreases as the altitude increases.
- Similarly, high temperatures reduce engine power and more so as the altitude increases (effect of density altitude that corresponds to the pressure altitude corrected by the temperature effect).
- As the performance of an aeroplane decreases with weight, it is advisable to avoid flying in the mountains with a weight that is too high.
- Passes or crests should be cleared from above. It is therefore necessary to study the safety altitudes during flight preparation and to allow sufficient margins, in particular with aerological conditions and/or high temperatures.
- When an aircraft is heading towards upward sloping terrain, the horizon perceived by the pilot's brain is always located several degrees above the true horizon. The involuntary and unconscious shift of the pitch attitude reference to 0° may rapidly lead to an excessive angle of attack that reduces climb performance and may lead the aircraft to the backside of the power curve or even stall.
- The turn radius of a light aeroplane increases with altitude as the difference between the true speed and the indicated air and ground speeds also increases. It is therefore advisable for pilots to always fly along the side of a valley in order to be able to easily perform a turn-around, if possible into the wind to avoid turbulence downwind of the terrain (see Figure 5), and on the sunny side to ensure optimum lift.

The Threat and Error Management (TEM) approach provides pilots with tools to implement a risk management process before and also during the flight, through the assessment of the various potential threats and/or errors and the implementation of solutions and

⁽⁷⁾ European regulation ("Regulation No 1178/2011 known as "Air Crew", [version in force on the day of the accident](#), see FCL.815) and national regulation (Order of 14 December 2017, [version in force on the day of the accident](#)).

⁽⁸⁾ See the practical guide published by the French Aeronautical Federation (FFA): [RP Pilotes de plaine et vol en montagne of 01 December 2021](#)

mitigation measures that may prevent an unwanted situation. When applied to a flight in a mountainous area, it is necessary to consider the specificities and best practices listed above and to know when to cancel, to never insist, to always have a way out, a plan B and comfortable safety margins.



Source: Centre National de Vol à Voile de Saint Auban

Figure 5: illustration of downdrafts downwind of the terrain

At the beginning of 2022, the BEA also published its safety lessons based on investigation reports published in 2021. Concerning light aeroplanes (<https://bea.aero/en/bilans-etudes/enseignements-2021/avions-legers/>) one of the topics included due to its recurrence and its consequences was “*Insufficient knowledge or experience for mountain flying*”. One of the purposes of this report is to make clubs, instructors and pilots aware of the topics to be considered for flight safety.

3 - CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation. They are not intended to apportion blame or liability.

Scenario

After carrying out two aerodrome circuits at Annecy-Meythet, the student-pilot and the instructor headed in the direction of Chambéry - Challes-les-Eaux to make the student-pilot's first cross-country flight. The instructor knew the region of Challes-les-Eaux as he had carried out glider flights and mountain flights there several years before.

They made the cross-country flight by the west, over the plain, and performed a full-stop landing at Chambéry - Challes-les-Eaux before taking off again in the direction of Annecy, navigating using natural or artificial references in the Bauges Mountains located to the east.

A few minutes after take-off, the aeroplane made a complete left-hand turn in the vicinity of Thoiry, probably to gain altitude before entering the valley leading to Col des Prés pass. The aeroplane then flew at low height in the centre of the valley downwind of a crest. The

area could be subject to turbulence or downdrafts, strong enough to negatively impact an aeroplane's climb performance.

Probably realising, after bypassing the ridge, that the aeroplane's altitude was not sufficient to clear the pass, the pilots attempted a right-hand turn-around during which the aeroplane collided with the vegetation then the ground. A fire broke out immediately on impact.

Contributing factors

The following factors may have contributed to the attempted turn-around before flying over a pass and then to the collision with the terrain:

- An insufficient altitude margin when entering the valley to be able to safely clear the pass coming up shortly after. This could have been due to:
 - an underestimation of the effects of the temperature, the aerological conditions and the altitude on the aeroplane's climb performance under the conditions of the day with a weight close to the maximum permissible weight;
 - the instructor's greater use, both in terms of total and recent experience, of high-performance twin-engine jet aircraft with visual references substantially differing from those on the CTLS.
- Flying the aeroplane in the centre of the valley:
 - reducing the possibilities of turning around;
 - potentially restricting the climb performance of the aeroplane that was downwind of the crest, in the presence of downdrafts and possibly in the shade.
- A lack of recent mountain flying and flying-over-pass experience.
- The choice of navigating using natural or artificial references, with flight over a pass, on the return flight potentially inadequately or insufficiently prepared in light of the student-pilot's experience.

Safety lessons

Mountain flying has specificities due to the environment, such as unusual visual references due to the loss of the natural horizon, reduced operational performance, complex and changing aerological conditions and restricted manoeuvring space. Specific knowledge and skills are required to fly safely in this restricted and demanding environment (see para. 2.6). Therefore, a sufficient altitude margin when making a cross-country flight, especially for the first time, is a safety guarantee, with the aim being to always have enough margin to be able to react in the event of difficulty.

Moreover, the occurrence highlights the importance of recent experience (even for instructors) of mountain flying and its specificities, as well as of experience in the type of aeroplane used and its performance, to be able to fly safely in a mountainous area and in particular when flying over a pass.

The FFA has compiled a quiz entitled "*PETITE VIRÉE EN MONTAGNE*" (short flight in the mountains) that enables pilots to assess their knowledge and then to discuss the results with their instructors before undertaking a mountain flight.

Safety actions taken by the operator following the accident

The operator implemented the following safety actions after the accident, in particular to reduce the risk associated with flying in a mountainous area for student-pilots in training:

- solo flights in the mountains have been prohibited;
- a prohibited flying area in mountainous areas has been defined for flights made by the ATO, with an exception made for "advanced" student-pilots or with the agreement of the training manager.