

AA2020-5

**AIRCRAFT ACCIDENT
INVESTIGATION REPORT**

**CENTRAL JAPAN AERONAUTIC ASSOCIATION, GIFU DIVISION
J A 5 0 5 G**

August 27, 2020



The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board and with Annex 13 to the Convention on International Civil Aviation is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

TAKEDA Nobuo
Chairman
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

AIRCRAFT ACCIDENT INVESTIGATION REPORT

AIRCRAFT DAMAGE DURING FORCED LANDING CENTRAL JAPAN AERONAUTIC ASSOCIATION, GIFU DIVISION Glaser-Dirks DG-500 ELAN ORION (GLIDER, TWO-SEATER), JA505G MATSUMOTO CITY, NAGANO PREFECTURE AT AROUND 12:17 JST, MAY 2, 2019

July, 17 2020

Adopted by the Japan Transport Safety Board

Chairman TAKEDA Nobuo
Member MIYASHITA Toru
Member KAKISHIMA Yoshiko
Member MARUI Yuichi
Member MIYAZAWA Yoshikazu
Member NAKANISHI Miwa

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident	<p>On Thursday, May 2, 2019, a Glaser-Dirks DG-500 Elan Orion, registered JA505G, operated by the Central Japan Aeronautic Association, Gifu Division while flying a leisure flight, suffered substantial damage to the aircraft when attempted a forced landing to the south slope of Mt. Yakedake.</p>
1.2 Outline of the Accident Investigation	<p>The Japan Transport Safety Board designated an investigator-in-charge and an investigator on May 3, 2019 to investigate this accident.</p> <p>An accredited representative of the Federal Republic of Germany, as the State of Design of the glider involved in the accident, and an accredited representative of the Republic of Slovenia, as the State of Manufacture of the glider involved in the accident, participated in the investigation.</p> <p>Comments on the draft report were invited from parties relevant to the cause of the accident and the relevant States.</p>

2. FACTUAL INFORMATION

2.1 History of the Flight	<p>According to the statement of the captain and records of portable GPS receiver, the history of the flight is summarized as follows. (The numbers shown in this text correspond to those in the Figures.)</p> <p>At around 11:44 Japan Standard Time (JST, UTC+9 hours, unless otherwise stated all times are indicated in JST on a 24-hour clock) on May 2, 2019, a Glaser-Dirks DG-500 Elan Orion, registered JA505G, operated by the Central Japan Aeronautic Association, Gifu Division was launched by aerotow from Runway 28 at the Hida Air Park (714m Elevation ①) in Takayama City, Gifu Prefecture for a leisure flight, with the captain in the</p>
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front seat and the passenger in the rear seat. In order to show the mountain scenery to the passenger, the captain made a plan to fly to and from Mt. Yotsudake, one of the mountains constituting Mt. Norikura *1, and return at around 13:00. After the launch, the Glider released from the towplane at an altitude of about 1,700 m, about 5 km east-southeast of the Hida Air Park. After climbing in thermals, the Glider was heading for Mt. Norikura and flew along the mountain ridge.

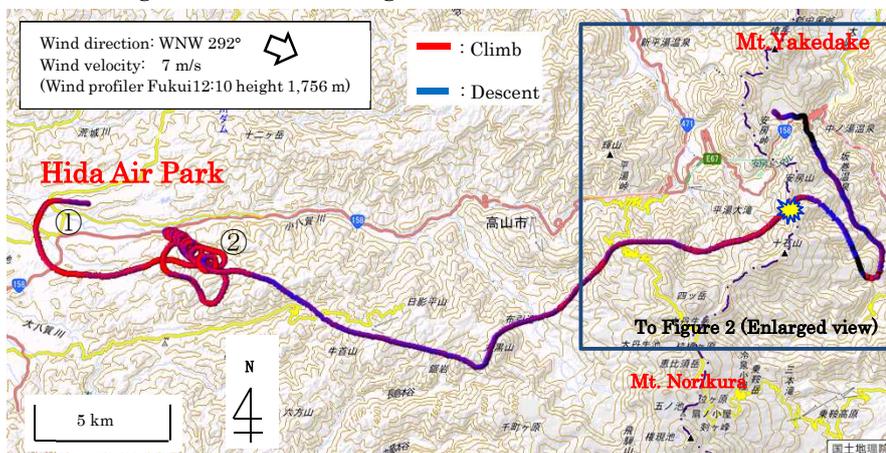


Figure 1: Flight route of the Glider (from Captain GPS recorder)

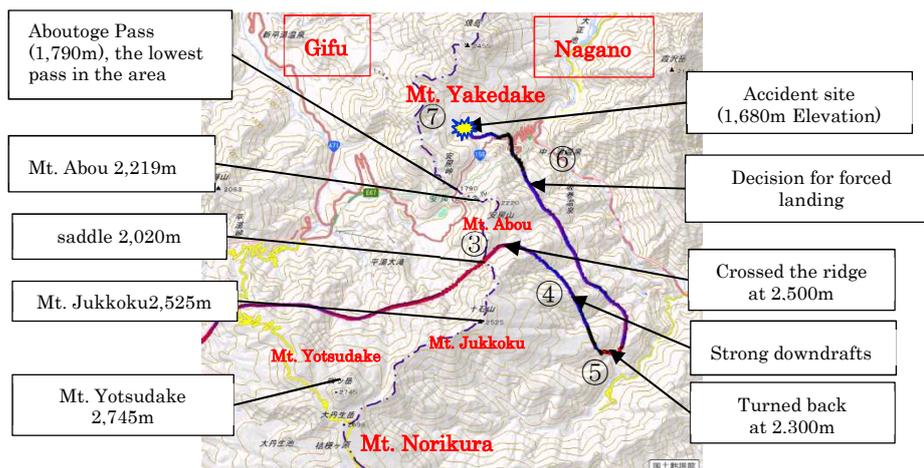


Figure 2: Flight route of the Glider (Enlarged)

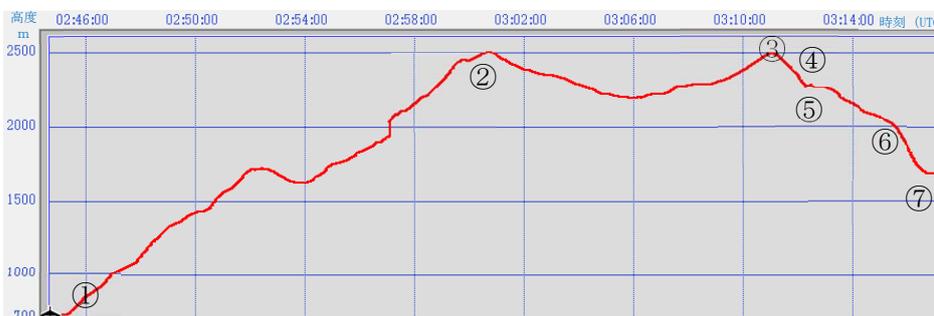


Figure 3: Cross section of the estimated flight route

When the Glider reached altitude of about 2,500 m (③) near Mt. Jukkoku, the captain intended to fly further north towards Mt. Yakedake, but as the altitude was low, he tried to fly close to the mountain slope to

*1 Mt. Norikura is a generic term for the mountains with Mt. Kengamine in the southern part of the Hida Mountains as its highest peak (3,026m Elevation), consisting of Mt. Yotsudake, Mt. Jukkoku and Mt. Abou.

	<p>gain altitude with the ridge lift. As the captain was concentrating too much on maintaining distance from the slope, he looked away from Mt. Yakedake. While flying along the slope, the Glider encountered strong downdraft. The captain assumed that it was the downdraft from the valley of Aboutoge Pass and it would turn into updrafts after passing over the valley, so he kept on flying. The Glider reached the point where the downdraft became weaker, but had lost considerable altitude, so the captain turned back to return to the original updraft place. At this time, unexpectedly the captain visually recognized Mt. Yakedake to the right, therefore, he thought he had passed Mt. Yakedake to the north without even noticing, turned back and flying southward. The Glider entered the downdraft again, the height from the ground has decreased, and the mountain slope came close.</p> <p>According to records on GPS, the Glider turned southeast at Mt. Jukkoku instead of north towards Mt. Yakedake, and continued to fly over saddle located between Mt. Jukkoku and Mt. Abou and crossed the ridge of Mt. Norikura from its upwind side to its lee side (④). As the Glider rapidly lost altitude since there was the strong downdraft at about -3 m/s on the lee side of the ridge, the captain flew through the downdraft at an altitude of about 2,300 m and made a turn to return (⑤), but the Glider entered into the downdraft again and lost more height.</p> <p>At an altitude of about 1,800 m, the captain felt that the ground height decreased and he thought that he had no choice but to make a forced landing, but there was no suitable open space for the landing, therefore, he found a forest with thin trees on gentle slopes and decided to make a forced landing by making contact with those trees to decrease the speed (⑥). Upon force landing, the Glider contacted trees, breaking fuselage and right wing, and came to rest with the nose down and hanging from trees. (1,680m Elevation ⑦)</p> <p>It was not until the captain was rescued and told the place where he was found was not in Gifu Prefecture but in Nagano Prefecture that he realized he had gone over the ridge and drifted into the downdraft area on the lee side of the ridge. Until then, captain believed that the forced landing site was on the west slope of Mt. Yakedake.</p> <p>This accident occurred at around 12:17 on May 2, 2019, on the south slope of Mt. Yakedake, Azumino Kamikochi in Matsumoto City, Nagano Prefecture (Latitude 36°12' 28" N, Longitude 137°35' 17" E).</p>
2.2 Injuries to Persons	None

2.3 Damage to the Glider	<p>Extent of damage: Destroyed</p> <ul style="list-style-type: none"> - Main wings: Right main wing broken - Fuselage: Tail broken 	 <p style="text-align: center;">Figure 4: Accident site</p>															
2.4 Personnel Information	<p>Captain: Male, age 59</p> <table border="0" style="width: 100%;"> <tr> <td>Private pilot certificate (High class glider)</td> <td style="text-align: right;">March 3, 2009</td> </tr> <tr> <td>Pilot competency assessment (Glider)</td> <td style="text-align: right;">Validity date: April 6, 2020</td> </tr> <tr> <td>Flight instructor rating (Glider)</td> <td style="text-align: right;">May 24, 2017</td> </tr> <tr> <td>Aviation medical certificate Class2</td> <td style="text-align: right;">Validity date: March 24, 2020</td> </tr> <tr> <td>Total flight time</td> <td style="text-align: right;">369 hours 22 minutes</td> </tr> <tr> <td>Total flight time on the type of Glider</td> <td style="text-align: right;">72 hours 53 minutes</td> </tr> </table>		Private pilot certificate (High class glider)	March 3, 2009	Pilot competency assessment (Glider)	Validity date: April 6, 2020	Flight instructor rating (Glider)	May 24, 2017	Aviation medical certificate Class2	Validity date: March 24, 2020	Total flight time	369 hours 22 minutes	Total flight time on the type of Glider	72 hours 53 minutes			
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2.5 Aircraft Information	<p>Aircraft type: Glaser-Dirks DG-500 Elan Orion</p> <p>Serial number: 5E174X26 Date of manufacture: August 29, 1997</p> <p>Airworthiness Certificate: No. 2018-61-01 Validity: June 16, 2019</p> <p>When the accident occurred, the weight and the center of gravity of the Glider were within the allowable ranges.</p>																
2.6 Meteorological Information	<p>(1) According to the statements of the captain and the Club members, the meteorological conditions at the time of this accident were fine, and the visibility was good. The cloud cover was about 3/8 in the morning but later it cleared out to be 1/8.</p> <p>There were clouds with base around 2,700m over Mt. Norikura (3,020 m) and Mt. Hotaka (3,190 m), and both summit was in the clouds.</p> <p>(2) The wind direction and wind velocity observed at the Hida Air Park (located about 25 km west of the accident site) were as follows:</p> <table border="1" data-bbox="486 1563 1364 1825" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Observation time</th> <th colspan="2" style="text-align: center;">Averages of wind direction and wind velocity (10 minutes) m/s</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">11:30</td> <td style="text-align: center;">West</td> <td style="text-align: center;">6</td> </tr> <tr> <td style="text-align: center;">12:00</td> <td style="text-align: center;">Northwest</td> <td style="text-align: center;">8</td> </tr> <tr> <td style="text-align: center;">12:30</td> <td style="text-align: center;">Northwest</td> <td style="text-align: center;">9</td> </tr> <tr> <td style="text-align: center;">13:00</td> <td style="text-align: center;">North-northwest</td> <td style="text-align: center;">6.5</td> </tr> </tbody> </table>		Observation time	Averages of wind direction and wind velocity (10 minutes) m/s		11:30	West	6	12:00	Northwest	8	12:30	Northwest	9	13:00	North-northwest	6.5
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(3) Weather chart on the day of the accident

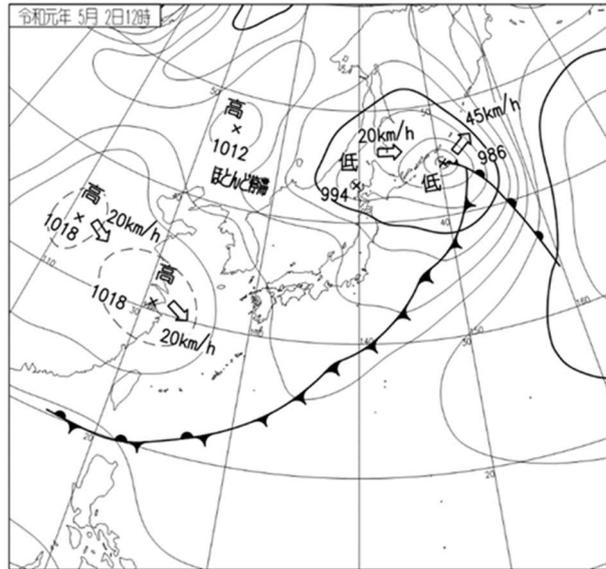


Figure 5: Weather chart on the day of the accident

(4) The observation data from the wind profiler at Fukui (located about 123 km west of the accident site) as of 12:10 on the day of the accident was as follows:

Altitude (m)	Wind direction	Wind velocity (m/s)
1,756	West-northwest 292°	7
1,464	West-northwest 282°	5

2.7 Additional Information

(1) Ridge soaring using slope lift

“Glider Flying Handbook” (2013, p.9-19 to 9-20) published by the U.S. Department of Transportation FEDERAL AVIATION ADMINISTRATION Flight Standard Service (FAA-H-8083-13A) describes the glider’s ridge soaring using slope lifts as follows. What follows are excerpts from this document.

Slope or ridge soaring refers to using updrafts produced by the mechanical lifting of air as it encounters the upwind slope of a hill, ridge, or mountain. Slope soaring requires two ingredients: elevated terrain and wind.

Slope lift is the easiest lift source to visualize. When it encounters topography, wind is deflected horizontally, vertically, or in some combination of the two.

Just as the flow is deflected upward on the windward side of a ridge, it is deflected downward on the lee side of a ridge. [Figure 6] This downdraft can be alarmingly strong—up to 2,000 fpm (10 m/s) or more near a steep ridge with strong winds. Even in moderate winds, the downdraft near a ridge can be strong enough to make penetration of the upwind side of the ridge impossible.

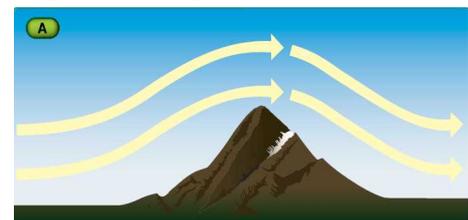


Figure.6 Ridge Soaring

(2) General Spec and Performance of the Glider

The Chapter 1 Summary of aircraft flight manual (AFM) have following description.

The wing area is 17.6 m² at wing span 20.00 m.

The Chapter 5 Performance of AFM have following description.

5-3-2 Glider performance

Performance data

(Wing span : 20 m)

<i>Wing loading.</i>	<i>kg/m²</i>	<i>30</i>	<i>35</i>	<i>42.6</i>
<i>Best glide ratio</i>		<i>43.5</i>	<i>43.8</i>	<i>44</i>

Upon the accident, the weight of the Glider was 591kg, so the wing loading was 33.6 kg/m². The best glide ratio can be calculated as 43.7.

(3) Instrument panel of the Glider

There were speed indicator, altimeter, vertical speed indicator, compass, navigation, radio and G-meter mounted on the instrument panel of the Glider. The

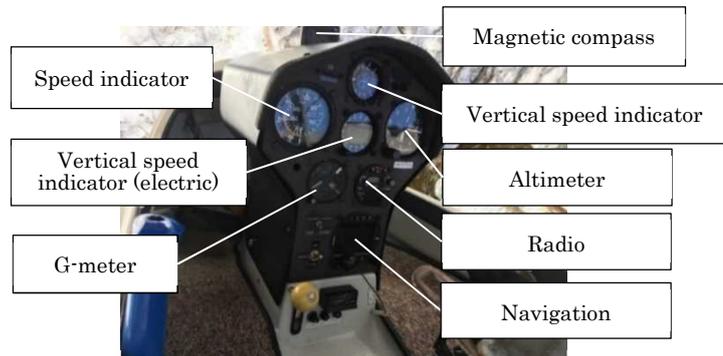


Figure 7: Instruments panel of the Glider

The navigation utilizes GPS signal and displays heading and area map. The captain was not used to use navigation nor compass, so he did not confirm the position and heading by these instruments at the time of the accident.

(4) Alternate landing site

The flight operations procedure of the Club described the radio frequency of Matsumoto Airport but did not specifically state it as alternate landing site. As there were no event in the past that an Glider was unable to return to the Hida Air Park due to altitude loss on the lee side of a ridge, the captain and the Club members was not prepared to use Matsumoto Airport located far side of the ridge as an alternate landing site.



Figure 8: Relative position of the Hida Air Park,

(5) Experience of the captain

The Club usually uses the runway at Gifu Base, Japan Air Self-Defense Forces for training. The Club has conducted training camp to the Hida Air Park to enjoy ridge soaring flights for the past 20 years, twice a year for 10

	<p>days each in May and September when northwest monsoon is available. The captain also has been participating in this expedition for eight years, and he had the flight experience around 60 hours in 57 days total flight time (75 launches) in this area.</p> <p>According to the the Club members, in the area of Hida Air Park, at first, pilots practice their ridge soaring skill in the area of Mt. Norikura, and then gradually expand flight area towards north. The captain had experience flying around Mt. Norikura, but never flown toward the north for Mt. Yakedake, Mt. Hotaka and others. Therefore, he was able to recognize main mountains such as Mt. Norikura and Mt. Yakedake, but unable to recognize smaller peaks such as Mt. Jukkoku and Mt. Abou, therefore, it was difficult for him to recognize position and heading of the Glider only from visual reference of the surrounding landscape.</p> <p>From his flight experience around Mt. Norikura, the captain knew that the glider may encounter the downdraft zone after crossing the ridge and entering into its lee side.</p>
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3. ANALYSIS

3.1 Involvement of Weather	None
3.2 Involvement of Pilots	Yes
3.3 Involvement of Aircraft	None
3.4 Analysis of Findings	<p>(1) Meteorological conditions</p> <p>(a) Wind on the day of the accident</p> <p>As shown in Figure 5, it is probable that the areas around Japan were in a weak west-high and east-low pressure system, and there were light northwesterly winds (about 7 m/s) at around the accident site.</p> <p>(b) Slope lifts in the area</p> <p>As shown in Figure 6, on the upwind side of the slope, there are ridge lifts created by wind flowing to the slope. From the landscape and wind conditions around the time of the accident, estimated updraft zone (red color) and downdraft zone (blue color) are as shown in Figure 9. It is highly probable that the Glider was in the updraft zone when flying west of Mt. Norikura. It is also highly probable that the Glider entered the downdraft zone and lost altitude as it crossed the ridge to the lee side near Mt. Jukkoku.</p> <p>While flying ridge soaring, it is important for the pilot to recognize updraft and downdraft zones expected from the relative position of the ridge and the wind direction, and always stay in the updraft zone.</p> <p>(2) Flight of the Glider</p> <p>(a) Flying to the downdraft zone</p> <p>When the captain was at Mt.Jukkoku intending to head north towards Mt.Yakedake, as he was concentrating too much on maintaining distance</p>

from the slope, and looked away from his visual target Mt. Yakedake, and did not check his heading with the instruments such as magnetic compass, it is probable that he did not notice that he had changed heading to the southeast. When the Glider entered the downdraft zone, it is probable that the captain erroneously thought that it was the downdraft affected by valley of Aboutoge Pass, and thus he kept flying without getting back right away. As the captain visually recognized Mt. Yakedake to the right when making a turn to return to the original place, he mistakenly thought he have already passed Mt. Yakedake to the north and going southward. The red arrow in Figure 9 shows what captain has stated how he believed the flight route. It is highly probable that the captain lost position and crossed the ridge of Mt. Norikura to the lee side, and entered the downdraft zone.

As the captain had never flown toward Mt. Yakedake crossing Aboutoge Pass, he did not have sufficient empirical knowledge on landscape and the shape of mountains to fly to Mt. Yakedake from Mt. Norikura, therefore, it is probable that he was not able to acknowledge position and heading of the Glider from the surrounding landscape. When flying in the area first-time, it is important to have sufficient knowledge by studying the maps in advance and familiarize landscape by training on a two seater glider.

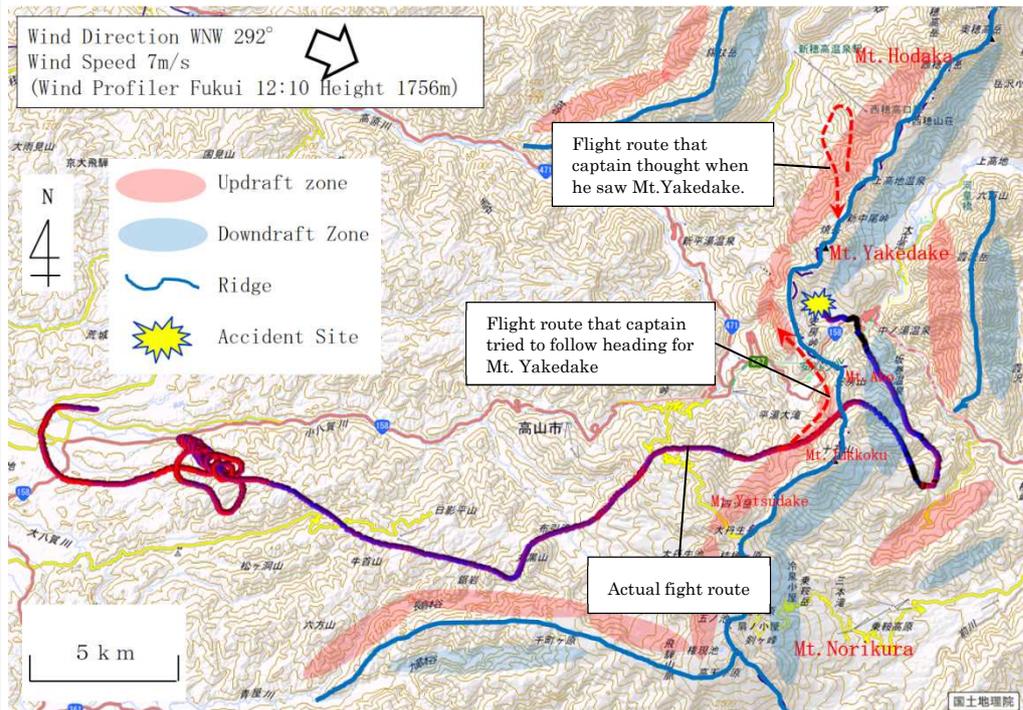


Figure 9: Slope lifts estimated from the landscape and wind conditions around the accident site

(b) Flight altitude

When crossing the ridge of Mt. Norikura, the Glider was flying at an altitude of about 2,500m, which is almost same altitude as Mt. Jukkoku nearby with an elevation of 2,525m. In light of the fact that there was the strong downdraft zone on the lee side of the ridge as described in 2.7 (1), it is probable that the height above ground was too low. As the captain intended to fly further north when he reached Mt. Yotsudake, the target of

this flight, it is probable that he should have gained altitude by flying back and forth several times in the updraft zone. Even if he could not be able to gain sufficient altitude, it is probable that he was able to return safely by turning back toward the Hida Air Park from that position.

While flying ridge soaring, it is important to keep altitude in consideration of the possibility of mistakenly entering into the lee side of a ridge and encounter downdraft.

(c) Confirmation of instruments

The Glider was equipped with a magnetic compass and a navigation with a map display. The captain was able to confirm the position and heading of the Glider with these instruments. As he was not used to check navigation instruments such as magnetic compass, it is probable that he was not able to notice his mistake on the heading.

Especially in crosscountry flight, it is important to fly not only by relying on the surrounding landscape, but also by properly recognizing the position and heading of the glider while referring to navigation instruments such as magnetic compass and maps.

(d) Alternate landing site

The captain had lost position and heading of the Glider, however if he had acknowledged them correctly, from the Glider glide ratio, wind direction and velocity, it is most likely that he may have reached and land safely to Matsumoto Airport. Glider pilots always needs to fly considering whether he have suitable landing site within his glide range. The captain should have prepared the radio frequency and the landing method of Matsumoto Airport, considering that he might mistakenly fly to downdraft zone on the lee side of the ridge.

(e) Forced landing

As the captain missed to keep target in sight and flew along the slope, he lost the position and wandered into the downdraft zone on the east side of Mt. Norikura ridge. As he lost altitude, it is highly probable that he gave up flying and made the decision to make a forced landing to the forest. It is highly probable that the Glider collided with trees, causing serious damage.

4. PROBABLE CAUSES

This accident occurred while flying ridge soaring, the Glider wandered into the downdraft zone on the lee side of the ridge and lost altitude. As the captain tried to make a forced landing to the forest, it is highly probable that the Glider collided with trees, causing damage.

Concerning the reason why the Glider wandered into the downdraft zone on the lee side of the ridge, it is highly probable that he lost his position because the captain did not have sufficient knowledge on the landscape as he had never flown and additionally he was flying without confirming the heading and position with instruments.

5. PREVENTIVE ACTIONS

Upon the occurrence of the accident, the Central Japan Aeronautic Association, Gifu Division has made known to its Club members the following preventive actions.

(1) Pilots' familiarity with the flying areas and ensuring of flight altitude

The Club members shall be given prior safety education and a familiarity with the flying areas in order to ensure that the captain should have sufficient knowledge. And the requirements for a pilot to engage in a flight as a captain were revised and the safety altitude in each area was clarified in the flight operations procedure.

(2) Confirmation of instruments

The education shall be given to the Club members in order to ensure that they can understand the importance of the use of instruments like a magnetic compass and use those instruments positively during cross-country flight.

(3) Ensuring of alternate landing sites

It was set out in the flight operations procedure that Matsumoto Airport shall be considered as an alternate landing site.