AA2023-7

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

Solaseed Air Inc.
J A 8 0 7 X

October 26, 2023

Japan Transport Safety Board

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
Chairperson
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.

《Reference》

The terms used to describe the results of the analysis in "3. ANALYSIS" of this report are as follows.

i) In case of being able to determine, the term "certain" or "certainly" is used.
ii) In case of being unable to determine but being almost certain, the term "highly probable" or "most likely" is used.
iii) In case of higher possibility, the term "probable" or "more likely" is used.
iv) In a case that there is a possibility, the term "likely" or "possible" is used.

AIRCRAFT ACCIDENT INVESTIGATION REPORT

CABIN CREW MEMBER INJURY BY SHAKING OF THE AIRCRAFT
SOLASEED AIR INC.
BOEING 737-800, JA807X
AT AROUND FL260 OVER ABOUT 120 KM
SOUTHWEST OF NAHA AIRPORT
AT ABOUT 08:37 JST, JULY 16, 2022

October 6, 2023

Adopted by the Japan Transport Safety Board

Chairperson TAKEDA Nobuo
Member SHIMAMURA Atsushi
Member MARUI Yuichi
Member SODA Hisako
Member NAKANISHI Miwa
Member TSUDA Hiroka

1. PROCESS AND PROGRESS OF THE AIRCARFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident	On Saturday, July 16, 2022, while a Boeing 737-800, JA807X, operated by Solaseed Air Inc., as a scheduled flight 41 of the Company, was flying from Naha Airport to New Ishigaki Airport, the aircraft was shaken, causing a cabin crew member to sustain an injury.
1.2 Outline of the Accident Investigation	Upon receipt of the notification of the accident occurrence, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and two other investigators on July 16, 2022 to investigate this accident. Although this accident was notified to the United States of America, as the State of Design and Manufacture of the aircraft involved in this accident, the State did not designate its accredited representative, etc. Comments on the draft Final Report were invited from parties relevant to the cause of the accident and the Relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight	According to the statements of all the crew members (two flight crews and four cabin crews) as well as the records of the Flight Data Recorder (FDR) of the aircraft, the history of the flight is summarized as below. On July 16, 2022, at 08:24 Japan Standard Time (JST: UTC + 9hrs, unless otherwise stated all times are indicated in JST on a 24-hour clock), a Boeing 737-800, JA807X, operated by Solaseed Air Inc., as a scheduled flight 41 of the Company, with a total of 135 people on board, consisting of the Pilot in Charge (PIC), five other crew members, and 129 passengers, took off from Naha Airport for New Ishigaki Airport.

In the pre-flight briefing started from about 07:20, the flight crew members confirmed the weather conditions. According to the weather conditions, it was expected that there would be no significant turbulence when climbing from Naha Airport and descending to New Ishigaki Airport, however, during cruising, there would be some jolts due to clouds developed around Miyako Island confirmed on the radar echo*1screen. With the First Officer (FO), the PIC shared the information such that the return flight would require attention because the clouds would be farther developed to have a great impact, and any pilots report about turbulence, including reports from other companies' flights had not been issued so far. In addition, they decided to set the cruising altitude at the pressure altitude of 26,000 ft (approx. 7,900 m, Flight Level (FL*2) 260). The flight crew members made a briefing with the cabin crew members via the intercommunication systems and shared this information.

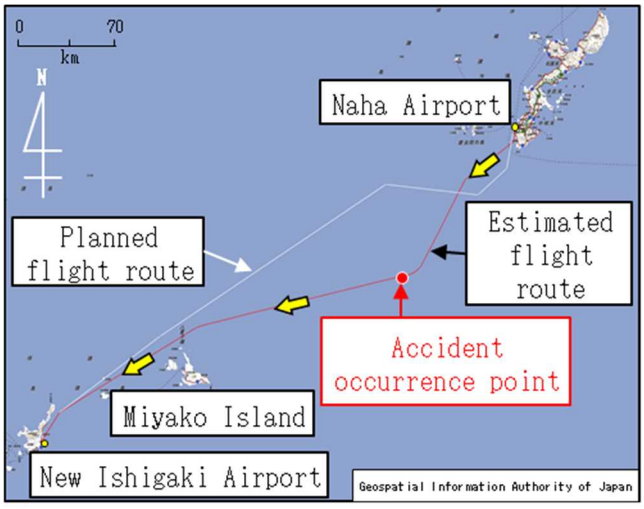

Figure 1 Estimated Flight Route

In the cabin crew members' briefing before boarding the aircraft, the Crew in Charge (CIC) instructed three cabin crew members not to serve hot drinks using service carts but to deliver cold drinks on trays because according to the weather conditions, turbulence was expected and the in-flight service time could be shortened. Based on the information from the cockpit, the CIC shared the arrangement to use trays as planned among cabin crew members.

In the cockpit of the aircraft, the PIC sat in the left seat as PF*3 and the FO in the right seat as PM*3. In the cabin, four cabin crew members were assigned as follows:

Front left (L1) : CIC
Front right (R1) : Cabin Crew A
Back left (L2) : Cabin Crew B
Back right (R2) : Cabin Crew C

*1 "Radar Echoes" refer to the reflective waves captured on the radar as radio waves emitted from a metrological radar are reflected by raindrop and ice particle, etc. The reflective waves allow to observe the distribution of precipitation area and the intensity, and this precipitation area may be also called "Echoes.

*2 "FL" is the altitude expressed as a numerical value obtained by dividing the altimeter instruction (unit: ft) when the altimeter setting value is set to 29.92 inHg at the pressure altitude of the standard atmosphere by 100. Flight levels are usually used in flight altitudes above 14,000 ft in Japan. As an example, FL260 represents altitude 26,000 ft.

*3 "PF and PM" is a term for identifying a pilot from role sharing in an Aircraft controlled by two people. The PF (Pilot Flying) is mainly responsible for maneuvering the aircraft. The PM (Pilot Monitoring) mainly performs monitoring of flight condition of the aircraft, and makes cross check of operation of PF and operations other than maneuvering.

As visually recognizing developing clouds on its flight path after the take-off, the PIC changed the heading from 240° to 215° with a clearance from the ATC, and continued to climb. At about 08:30, the PIC confirmed the weather conditions visually as well as by using the airborne radar, and found that there was neither developing cloud on the flight path nor turbulence, therefore turned off the seat belt sign.

After the seat belt sign was turned off, the cabin crew members started in-flight service. Cabin Crew A began to provide passengers with drinks on trays from the first row, and Cabin Crew C from the 15th row toward the aft part. In addition, the CIC prepared for the drinks to resupply and were standing by in the forward galley, and Cabin Crew B did same thing as the CIC in the aft galley.

In order to head for the flight route on the original flight plan, the aircraft changed the heading with a clearance from the ATC at 08:35:28. At 08:35:50, the aircraft reached the cruising altitude of FL260. After changing the heading, despite of the ongoing unshaking conditions, the PIC thought that there was no cumulonimbus ahead and a clear sky was seen, but the clouds, which had been visually recognized approx. 2,000 ft below, were flat at the apex, neither like cumulonimbus clouds in shape nor seemingly going to develop, but seemed to be close enough to be sensible. Therefore, the PIC thought of going to secure sufficient altitude difference by climbing from FL260 to FL280 in order to ensure the safety. The aircraft commenced climbing with a clearance from the ATC at 08:36:25, but the clouds, which had seen below just moments before, were developing on the flight route when the aircraft started climbing, and looming directly below the aircraft. At 08:36:41, the moment the aircraft passed over the developing clouds at close range, the shaking as if to hold his body down occurred.

This sudden shaking took a toll on the CIC and Cabin Crew A, who were exchanging the tray after delivering the drinks and the tray for the resupplied drinks in the forward galley, and they fell down on the floor and landed on the butts as holding the trays with their both hands. At this time, Cabin Crew A was made in a position like sitting sideways with left leg down and felt pain in the left foot. Cabin Crew B, who was standing by after placing the tray for the prepared drinks in the aft galley, squatted down with her knees bent. Cabin Crew C, who had just finished delivering drinks to the passengers in the 17th row, fell on the back while scattering the paper cups containing drinks, and landed on the butt (Figure 2).

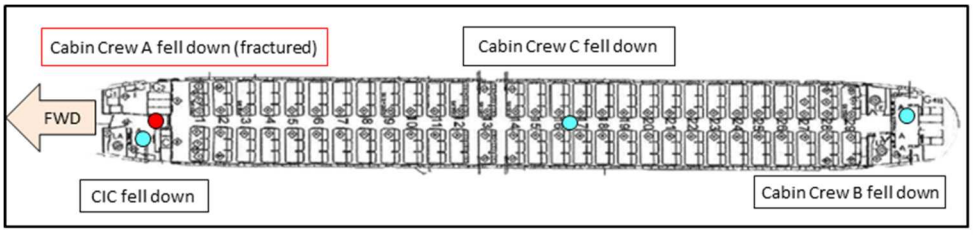

Figure 2: Locations of Cabin Crew Members at the Time of Aircraft Shaking

All the passengers were seated and no one suffered injuries.

	The PIC thought although the aircraft was strongly shaken momentarily due to unexpected approach of clouds, there was no continuous shaking after that, there would be no clouds or air currents likely to affect the further flight path and did not turn on the seat belt sign. When the PIC confirmed the conditions of the cabin, the CIC reported to the PIC that as Cabin Crew A fell down due to the turbulence and sustained injury in the left foot, disabling to continue the duties, therefore the cabin crew members were to switch to the setup with three members. The PIC decided to continue heading for New Ishigaki Airport because there were developed clouds around Naha Airport, and reported to the flight dispatcher at New Ishigaki Airport that one cabin crew member was injured due to the turbulence, and requested medical arrangements. The aircraft landed at New Ishigaki Airport at 09:04. Cabin Crew A was diagnosed with a fracture of the fifth metatarsal bone of the left foot (the outermost bone of the left instep that leads to the little toe) at the medical facility in Ishigaki City. This accident occurred about 08:37, on July 16, 2022, at vicinity FL260 over about 120 km southwest of Naha Airport (25°20'44" N and 126°50'33" E).

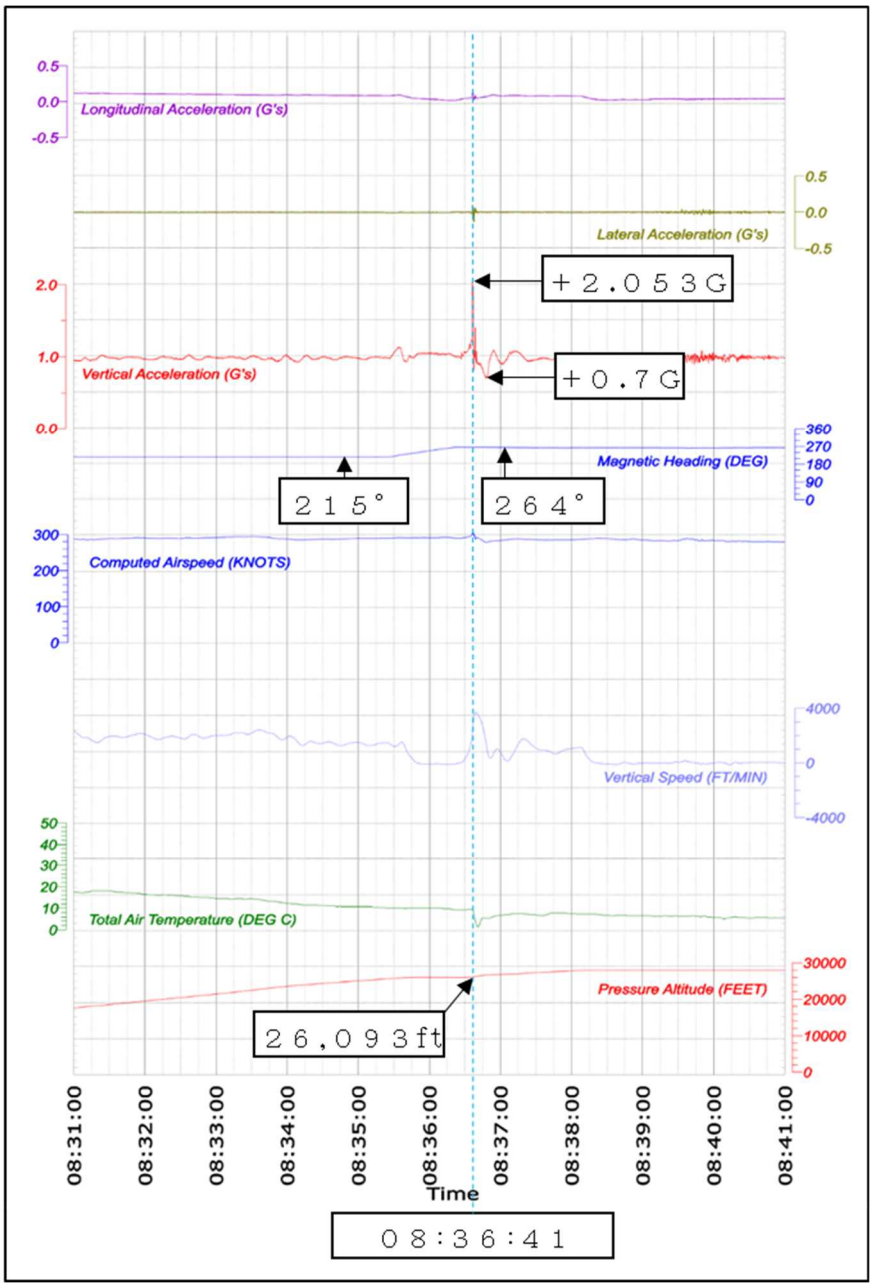

Figure 3: FDR Records

2.2 Injuries to Persons	Cabin Crew A was seriously injured (a fracture of the fifth metatarsal bone of the left foot).
2.3 Damage to the Aircraft	None
2.4 Personnel Information	(1) PIC: Age 34 Airline transport pilot certificate (airplane) May 18, 2021 Type rating for Boeing 737 August 29, 2013 Class 1 aviation medical certificate Validity November 12, 2022 Total flight time 7,054 hours 58 minutes Flight time in the last 30 days 90 hours 06 minutes Total flight time on the type of the aircraft 6,475 hours 30 minutes Flight time in the last 30 days 90 hours 06 minutes

	(2) FO: Age 27 Commercial pilot certificate (airplane) May 26, 2017 Type rating for Boeing 737 August 29, 2020 Instrument Flight Certificate (airplane) March 30, 2018 Class 1 aviation medical certificate Validity March 6, 2023 Total flight time 1,688 hours 48 minutes Flight time in the last 30 days 66 hours 19 minutes Total flight time on the type of the aircraft 1,421 hours 13 minutes Flight time in the last 30 days 66 hours 19 minutes
2.5 Aircraft Information	Aircraft type: Boeing 737-800 Serial number: 39431 Date of manufacture: June 28, 2013 Certificate of airworthiness: No.TO-27-159 Validity Period since June 26, 2015, the Maintenance Manual (Skynet Asia Airways Co., Ltd.*4) has been effective. When the accident occurred, the weight and position of the center of gravity of the aircraft were within the allowable ranges.
2.6 Meteorological Information	(1) Weather Conditions in Airspace the Accident Occurred According to the preliminary weather chart (Figure 4) as of 09:00 on July 16, 2022, there was a low pressure in the north part of the Kyushu region, a stationary front was extending to the East China Sea. Developed convection cloud *5 zones were scattering near the Nansei Islands located on the south side of the front. And the Domestic Significant Weather Analysis Chart valid at 06:00 on July 16, 2022 (Figure 5) showed that the cumulonimbus clouds with a cloud top altitude reaching the vicinity of FL 430 were moving toward the east-northeast over the sea southeast of Miyako Island. According to the Domestic Significant Weather Prognostic Chart at 09:00 on July 16, 2022 which the PIC had confirmed in the pre-flight briefing (Figure 6), significant weather was not forecast in the relevant airspace. According to the meteorological satellite image (visible) as of 08:35 (Figure 7), the vicinity of the accident occurrence point is located on the northeast of the developed convection cloud zone. Based on the echo top height of radar echo composite chart, the cloud top height in the vicinity of the accident occurrence point changed at 08:30 from a dark green color indicating 5 to 6 km (FL164 to FL197) (Figure 8), at 08:35 to a yellow green color indicating 8 to 9 km (FL262 to FL295) (Figure 9), and at 08:40 after the aircraft had passed to a yellow color indicating 9 to 10 km (FL295 to FL328) which partially changed up to a pink color indicating 11 to 12 km (FL361 to FL394) (Figure 10). In addition, according to the radar echo

*4 "Skynet Asia Airways Co., Ltd." is the company name before it was changed to Solaseed Air Inc. on December 1, 2015, and the certificate of airworthiness was issued on June 26, 2015.
*5 "Convective Clouds" refer to clouds that are formed when updraft develops vertically.

composite chart, the echo intensity near the accident occurrence point at 08:35 was shown in a yellow green indicating 24 to 32 mm/h (Figure 11).

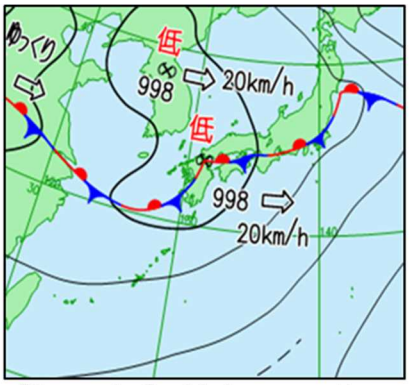

Figure 4: Preliminary weather chart at 09:00 on July 16, 2022 (Excerpt)

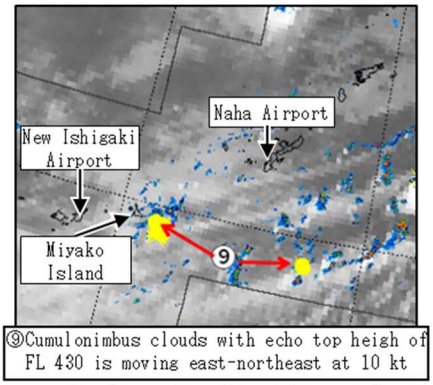

Figure 5: Domestic Significant Weather Analysis Chart at 06:00 on July 16, 2022 (announced at 06:21 on July 16, 2022) (excerpt and expand)

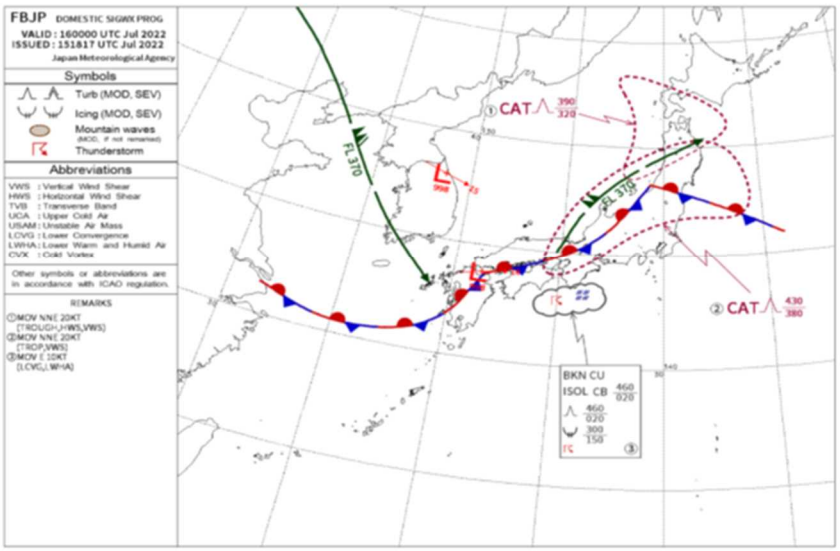

Figure 6 Domestic Significant Weather Prognostic Chart at 09:00 on July 16,2022(announced at 03:17 on July 16, 2022)

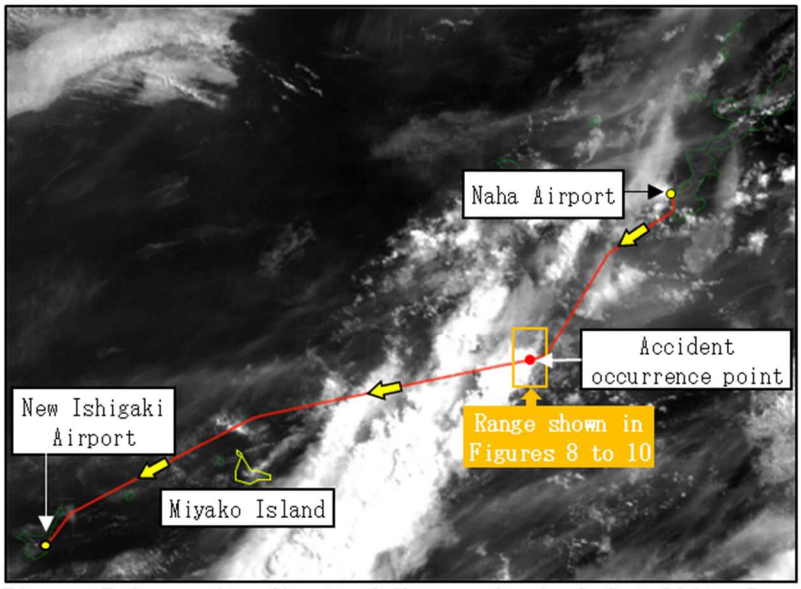

Figure 7 Composite Chart of Meteorological Satellite Image (visible) and Estimated Flight Route (at 08:35)

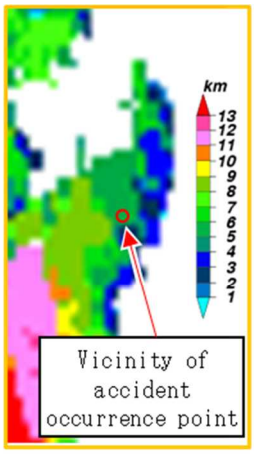

Figure 8
Echo Top Height
(08:30)

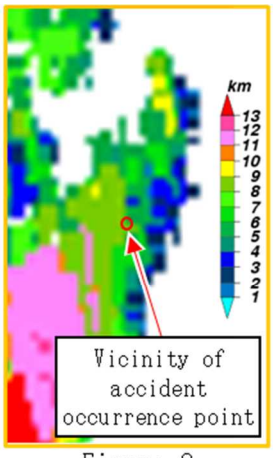

Figure 9
Echo Top Height
(08:35)

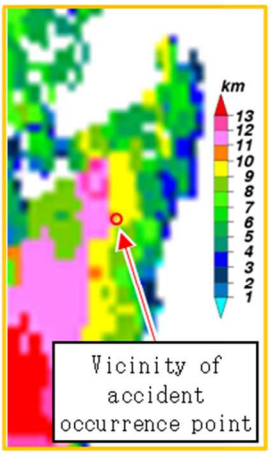

Figure 10
Echo Top Height
(08:40)

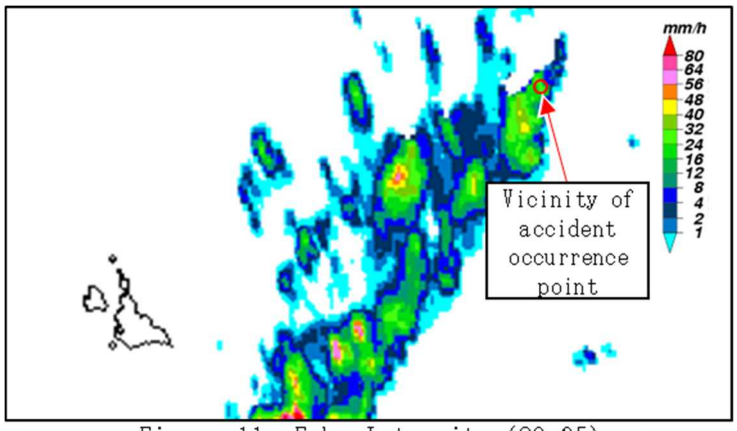

Figure 11: Echo Intensity (08:35)

(2) Domestic Significant Weather Analysis Chart and Domestic Significant Weather Prognostic Chart

The domestic significant weather analysis chart and domestic

	significant weather prognostic chart are introduced on the Japan Meteorological Agency website as follows: ・*Domestic Significant Weather Analysis Chart* *It is information chart that combines the real-time observations of turbulence and icing reported by aircraft into the imagery by a weather radar and meteorological satellite, and adds forecasters' jet stream analysis and brief comments on the significant weather. It is issued six times a day every three hours from 06:00 to 21:00 (Japan Standard Time) of the operation time for the domestic airlines.* ・*Domestic Significant Weather Prognostic Chart* *For the altitudes from the ground to the surface pressure of 150 hPa (approx. 14,000 m), the chart portrays forecasts of significant weather seriously affecting the operation of the aircraft such as lightning and turbulence, the location, central pressure, travel direction/speed and fronts of low- and high-pressure systems on the ground, and 0°C isothermal lines at 5,000 ft (approx. 1,500m) and 10,000 ft (approx. 3,000m). The chart is issued four times a day every six hours.*
2.7 Additional Information	(1) Avoidance of Cumulonimbus Regarding how to avoid a cumulonimbus (thunderstorm area), the Sections 851 in Aeronautical Information Manual Japan (AIM-J) (No. 77 (the first half (January 1 to June 30, 2023) edition), Published by Japan Aircraft Pilot Association) states as follows (excerpts): *f. Flight operations in a thunderstorm area* *a) Horizontal evasion: When avoiding a cumulonimbus, detour is the easiest and safest choice. It shall be desirable for the thunderstorm or significant radar echo that are rated as SEVERE to take the avoiding distance of 20 miles or more. A pilot should set his or her route on the windward side of cumulonimbus as much as practicable.* (Omitted) *The cumulonimbus varies the cloud top and composition of precipitating particles in accordance with the season (high temperature and low humidity) and area of formation (moist or dry); therefore, the actual conditions may not be evaluated by the strength of radar echoes and its appearance.* (Omitted) *b) Flight above a thunderstorm: A pilot should be on a circumnavigation unless it is cleared by 5,000 ft or above.*

3. ANALYSIS

(1) Meteorological Information

The JTSB concludes that according to Figure 7 and Figure 8: Echo Top Height at 5 Minute Intervals, as for the convection clouds near the accident site, the echo top height changed from an

altitude of 5 km at 08:30 to 9 km at 08:35, thus the maximum change was 4 km in 5 minutes, and that converting this maximum change into the vertical speed will be about 2,600 ft/min.

After 08:35:28 when the aircraft changed the heading until 08:36:41 when this accident occurred, it is likely that the top height of the clouds, which the PIC had tried to avoid and seen about 2,000 ft below, raise approximately by 3,200 ft at a maximum and reached close to about 27,000 ft.

Therefore, it is more likely that the developing speed of the convection clouds was so fast that the aircraft was unable to avoid turbulence with the flight operations to avoid the convection clouds by climbing after visually recognizing them seen below. In addition, based on the weather analysis that showed a cumulonimbus with cloud top height reaching near FL 430 was moving from the southeast of Miyako Island, it is more likely that the aircraft should have considered to avoid the convection clouds not vertically but horizontally.

The reason why the aircraft avoided the convective clouds vertically is probably because as there was no cloud in the flight direction, air currents were stable, and the clouds which the PIC had visually recognized was not in the shape of cumulonimbus, the PIC more likely judged it would be possible to avoid the clouds while returning to the originally planned flight route if they would increase enough altitude to take distance from the clouds.

In order to avoid a cumulonimbus, it is probably necessary to select the flight route based on the meteorological information and analysis obtained before flight, to grasp wind direction / velocity, total air temperature and clouds conditions by using not only the visual sighting, but also the airborne radar during flight, and to consider in advance the safe avoidance method depending on the situation based on the information as above. In addition, the clouds around a cumulonimbus may rapidly develop even though they do not appear to be a cumulonimbus, therefore, it is probably desirable to avoid them horizontally when sufficient altitude difference cannot be maintained. If avoidance is to be made vertically as avoiding them horizontally is difficult, it is desirable to provide the information to cabin crew members in advance and turn on the seat belt sign in order to ensure the safety in the cabin.

(2) Cabin Crew Member Fall by Shaking of the aircraft

The JTSB concludes that the FDR records show that at 08:36:41 when the aircraft passed over the developing convective clouds at close range, the vertical acceleration was +2.053G, and it is highly probable that the shaking as if to hold the body down that occurred at that time, due to which Cabin Crew A, who was standing with the trays in her both hands, fell down in a moment while being neither support the body, and was made in a position like sitting sideways with left leg down, resulting in the injury in the left foot.

4. PROBABLE CAUSES

The JTSB concludes that the probable cause of this accident was that when the aircraft passed over the developing convective clouds, occurred the shaking as if to hold the body down, due to which Cabin Crew A fell down in a position like sitting sideways with left leg down, resulting in the injury in the left foot. It is highly probable that the reason why the aircraft passed over the developing convective clouds is because as it was unable to anticipate the possibility that the clouds seen below would rapidly develop, the aircraft passed over.

5. SAFETY ACTIONS

5.1 Safety Actions Required	As described in "3. ANALYSIS", in order to avoid a cumulonimbus, it is probably necessary to select the flight route based on the meteorological information and analysis obtained before flight, grasp the change in the weather conditions during flight and clouds conditions by visual sighting but also using the airborne radar, and reconfirm how to select a safer avoidance method.
5.2 Safety Actions Taken after the Accident	Measures Taken by the Company after the Accident. (1) Awareness of Safety Issues ① The safety manager made the accident overview known to all employees promptly after the occurrence of this accident. In addition, the safety manager reconfirmed that the safety is the first priority, and reminded them that "flight safety", "customer safety" and "work safety" should be ensured. (July 16, 2022). ② The Cabin Crew Department made known about how cabin crew members should respond to turbulence while tending to the in-flight service in order to give first priority to personal safety protect themselves when turbulence is encountered. (August 22, 2022) In addition, the Cabin Attendant Manual was revised to stipulate such specific procedures to ensure the safety of cabin crew members as adding of how they should respond in case of encountering turbulence during in-flight services (CA Bulleting was issued on August 24, 2022, and reflected in Manual on October 1, 2022). ③ The Flight Safety Promotion Section delivered in-house document "FLIGHT SAFETY NEWS" to flight crew members, endeavoring to make them thoroughly aware that they shall take safety measures based on the detail analysis and forecast of weather information, grasp clouds conditions by using the airborne radar to decide the avoidance method, use the vertical avoidance as a last resort when avoiding developed clouds, and share risk awareness by making close contact with cabin crew members during in-flight services and calling attention. (August 22, 2022) (2) Preventive Measures ①The Company made the flight dispatcher thoroughly aware that they shall provide promptly the information to the relevant flights when turbulence rated Light Plus (which refers to such the level of turbulence that generally requires significant caution to carry out cabin services, and may temporarily cause the in-flight services to discontinue) or more on and in the vicinity of the planned flight route. ②In order to have common understanding about turbulence and share closely the information between flight crew members and cabin crew members, the Company decided to include joint discussions in the regular emergency rescue trainings and made a plan to implement them for all flight and cabin crew members.