AA2009-9

AIRCRAFT ACCIDENT INVESTIGATION REPORT

AIR CHINA LIMITED
B 2 9 0 6

October 30, 2009

Japan Transport Safety Board

The investigation for this report was conducted by the Japan Transport Safety Board, JTSB, about the aircraft accident of Air China Limited, Boeing 737-300 registration B2906 in accordance with the act for the Establishment of the Japan Transport Safety Board and Annex 13 to the Convention on the International Civil Aviation for the purpose of determining causes of the aircraft accident and contributing to the prevention of accidents/incidents and not for the purpose of blaming responsibility of the accident.

This English version of this report has been published and translated by the JTSB to make its reading easier for English speaking people who are not familiar with Japanese. Although efforts are made to translate as accurately as possible, only the Japanese version is authentic. If there is any difference in the meaning of the texts between the Japanese and English versions, the text in the Japanese version prevails.

Norihiro Goto,
Chairman,
Japan Transport Safety Board

AIRCRAFT ACCIDENT INVESTIGATION REPORT

AIR CHINA LIMITED
BOEING 737-300, B2906 (China)
ABOVE MATSUE CITY, SHIMANE PREFECTURE, JAPAN
AT ABOUT 19:19 JST, FEBRUARY 10, 2008

October 2, 2009

Adopted by the Japan Transport Safety Board

(Aircraft Sub-committee Meeting)

Chairman	Norihiro Goto
Member	Yukio Kusuki
Member	Shinsuke Endo
Member	Noboru Toyooka
Member	Yuki Shuto
Member	Akiko Matsuo

1. PROCESS AND PROGRESS OF AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On February 10 (Sunday), 2008, a Boeing 737-300, registered B2906, operated by Air China Limited, took off from Beijing Capital International Airport (People's Republic of China) bound for Kansai International Airport (Japan) on a scheduled Flight 161 of the company. At about 19:19 JST (Japan Standard Time, unless otherwise stated all times are indicated in JST, UTC+9h), while flying at an altitude of about 31,400 ft above Matsue City, Shimane Prefecture, the aircraft was shaken, and a passenger who was walking in the aisle in the aft cabin section was seriously injured.

There were 73 people on board, consisting of the PIC, 10 other crewmembers, and 62 passengers.

The aircraft was not damaged.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On February 11, 2008, the Aircraft and Railway Accidents Investigation Commission (ARAIC) designated an investigator-in-charge and two other investigators to investigate this accident.

1.2.2 Accredited Representative and Adviser of Foreign States

An accredited representative of the People's Republic of China, as the State of Registry and Operator of the aircraft involved in the accident, and an accredited representative and an adviser of the United States of America, as the State of Design and Manufacture of the aircraft, participated in the investigation.

1.2.3 Implementation of the Investigation

February 11, 12 and 18, 2008 Interviews

1.2.4 Comments from Parties Relevant to the Cause of the Accident

Comments were invited from parties relevant to the cause of the accident.

1.2.5 Comments from the Participating State

Comments were invited from the participating states.

2. FACTUAL INFORMATION

2.1 History of the Flight

On February 10, 2008, a Boeing 737-300, registered B2906 (hereinafter referred to as "the Aircraft"), operated by Air China Limited (hereinafter referred to as "the Company"), took off from Beijing Capital International Airport bound for Kansai International Airport on a scheduled Flight 161 of the Company. The flight plan submitted to the Fukuoka Area Control Center of the Ministry of Land, Infrastructure, Transport and Tourism is outlined below.

Flight rules:	Instrument flight rules (IFR)
Departure aerodrome:	Beijing Capital International Airport
Estimated off-block time:	17:25
Cruising speed:	431 kt
Cruising altitude:	FL350*1
Route:	Omitted – G597 (airway) – JEC (Miho VORTAC) – TRE (Tottori VOR/DME) – SAEKI (reporting point) – HAKBI (reporting point) – OKC (Okayama VORTAC) – ALISA (reporting point) – EDDIE (reporting point) – AJE (Awaji VOR/DME) – AKASI (reporting point)
Destination aerodrome:	Kansai International Airport
Estimated flight time:	2 h and 27 min

The Aircraft took off from Beijing Capital International Airport at 17:34, with 73 people on board, consisting of the PIC, 10 other crewmembers and 62 passengers. In the cockpit of the Aircraft, the Second PIC*2 sat in the left seat as the PF (pilot flying: pilot mainly in charge of flying) and the Co-Pilot sat in the right seat as the PNF (pilot not flying: pilot mainly in charge of duties other than flying). The PIC sat in a rear crewmember seat.

The cabin was staffed by a Chief Purser (CP), four Flight Attendants (FA), a maintenance engineer, a security staff member and an off-duty co-pilot.

According to the records of the Digital Flight Data Recorder (hereinafter referred to as "DFDR"), the air traffic control (ATC) communications records and the statements of the crewmembers and passengers, the history of the Aircraft's flight was summarized below.

2.1.1 Flight History Based on DFDR and ATC Communications Records

While flying over South Korea towards Miho VORTAC (JEC) at FL330 with the autopilot (hereinafter referred to as "A/P") engaged, the Aircraft received instructions from the Tokyo Area Control Center (hereinafter referred to as "Tokyo ACC") at a point just before JEC to fly directly to

*1 FL stands for Flight Level. It is the pressure altitude (ft) in the standard atmosphere. The FL is expressed in the value given by dividing the reading on the altimeter by 100, when the altimeter is set to 29.92 inHg. It is usually used at FL140 and higher.

*2 Second PIC is a Company-specific duty assigned to PIC-qualified pilots. The Second PIC is next in responsibility after the PIC, and supports or acts on behalf of the PIC.

SAEKI, and the heading was changed accordingly. Subsequently, at about 19:18:13, the Aircraft started descending.

While the Aircraft was descending at a rate of about 2,000 ft/min, the wind velocity began to drop at a steeper rate, the CAS*3 increased rapidly and the control column position (CCP)*4 moved towards the pitch-up direction at about 19:19:03, when the Aircraft was at a pressure altitude of about 31,500ft, and the A/P disengaged at about 19:19:06. Subsequently, the CCP changed back and forth. During the period from 19:19:08 to 19:19:11, the vertical acceleration showed remarkable change, dropping from about 2.2G to about 0.0G and then reaching again to about 2.0G. Until about 19:19:27, the pitch angle*5 had changed upward and downward following the changes in CCP, and the changes in the vertical acceleration accompanied by the changes in the pitch angle were recorded.
(See Figure 1 Estimated Flight Route and Figure 3 DFDR Records)

2.1.2 Statements of the Crewmembers

(1) PIC

The Second PIC was in the left seat controlling the Aircraft, the Co-Pilot was in the right seat, and I was in a rear crewmember seat. We were not alerted to anything special before the flight when the dispatcher gave us the METAR (aerodrome routine meteorological report) and the TAF (aerodrome forecast) for the airports relevant to takeoff and landing, in addition to the Upper Wind and Temperature Chart for FL340 and FL300 and the Significant Weather Prognostic Chart. The strong shaking occurred so suddenly that I had no way of anticipating it. Before that, there had been some lighter shaking but it did not cause any problems. The strong shaking occurred when flying at about 31,000 ft; it was "moderate" in magnitude. We normally keep the seat belt sign on throughout the flight from takeoff to landing in case of any possible shaking during the flight. The Aircraft was flying with the A/P engaged, but it was disengaged at the time of the strong shaking. About five minutes after the shaking, the CP reported that a passenger had been injured during the shaking, and an ambulance would be needed. I instructed the CP to keep watch on the passenger and I contacted our operations support service contractor at Kansai International Airport for an ambulance. We did not expect any delay in the scheduled arrival time since the ATC was giving instructions on the Aircraft's flight route to the destination. As I was told that the passenger had abdominal pains but was conscious and breathing normally, I did not request ATC priority handling.

(2) Second PIC

I had been controlling the Aircraft from takeoff to landing, sitting in the left seat. During

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*3 CAS stands for Computed Airspeed, meaning the airspeed displayed on the control panel after the position error and instrument errors of the airspeed system are calibrated and processed by the computer.

*4 Control column position (CCP) is the fore-aft position of the shaft (column) on which the control wheel is mounted. Regarding nose-up and nose-down control using the control column, "+" symbol indicates a nose-up operation accomplished by pulling back the column and "–" symbol indicates a nose-down operation accomplished by pushing the column forward.

*5 Regarding pitch angle, "+" symbol indicates nose-up and "–" symbol indicates nose-down.

the pre-flight briefing, the dispatcher's weather information did not include anything that required special attention. Although the cruise altitude in the flight plan was FL350, we actually flew at FL330 as cleared by the ATC. We had mild shaking when flying over South Korea, but in Japanese airspace there were no clouds and no radar echo, so I was able to see lights on the ground. I did not expect any significant turbulence. Just before JEC, Tokyo ACC instructed us to fly directly to SAEKI, and so I changed the heading. Subsequently, we received instructions to descend to FL250. Shortly after we started descending, there was some strong shaking. The seat belt sign stayed on throughout the flight. Coincidently with the shaking, the A/P automatically disengaged. Since I noticed too high a CAS when the A/P was disengaged, I controlled the Aircraft to change its attitude in such a way that the CAS would be decreased. The shaking abated in about 10 seconds, so I re-engaged the A/P. There was no damage to the Aircraft and the A/P operated normally around the time of the shaking. We did not report to the ATC that a passenger was injured during the shaking caused by turbulence, but we contacted our operations support service contractor at Kansai International Airport to have an ambulance ready.

(3) CP

During the pre-flight briefing, we were not informed of any weather conditions of concern. The seat belt sign remained illuminated throughout the flight. It was about 19:20 that we had strong shaking. At the time, I was sitting in my crew seat by the forward left door, making entries in the log after announcing to the passengers that the Aircraft was going to start its descent. Earlier on, there was some rather mild shaking, but then strong shaking suddenly occurred. The strong shaking lasted about a dozen or so seconds, or less than two minutes together with smaller shaking that followed.

When shaking occurs, we suspend in-flight service and advise the passengers over the PA not to use the lavatories, but once the shaking has abated, we allow the passengers to use the lavatories.

An FA in charge of the aft cabin section told me over the interphone that a passenger in that section had been injured. After advising the passengers over the PA to fasten their seat belts and not to use the lavatories, I went to the aft cabin section, where I saw the injured passenger seated in Seat 22D and being taken care of by the FA in charge of that section. Since I saw the daughter of the injured passenger approaching, I asked both of them about the conditions relevant to the injury. The passenger had lost her balance when returning from an aft lavatory to her seat, 13B. As the passenger complained of abdominal pains, I notified the PIC that an ambulance would be needed.

As we arrived at the airport, I asked the passengers over the PA for their cooperation in allowing the injured passenger to disembark first. When I opened the door, I saw that an ambulance was right there, so I let the ambulance crew into the Aircraft and they carried the injured passenger to the ambulance.

(4) FA in charge of the aft left section

I was in charge of the aft left lavatory. At the time the Aircraft started shaking, there were two passengers in the aisle. I told the one waiting for the lavatory to sit in a nearby

vacant seat and fasten the seat belt. Just when I was going to approach the other passenger who had just left the lavatory, strong shaking occurred. The Aircraft shook violently up and down and I felt as if I were being lifted into the air. The passenger who had just left the lavatory was on the floor of the aisle near Row 22 and was unable to raise herself up. A passenger in Seat 22E held the hands of the fallen passenger to help her into the unoccupied Seat 22D. The Aircraft had been shaking so violently that I had frantically tried to hold onto something to support myself, and was unable to see the passenger at the time she fell down. All the other passengers fastened their seat belts, and did not suffer any injuries. I have never before experienced such a strong shaking.

2.1.3 Statements of Passengers

(1) Injured passenger

The Aircraft shook on my way back to my seat from the lavatory, causing my body to be lifted, and my head hit against something and then my abdomen hit against a seat before I fell to the floor on my back. Even after I fell down, the Aircraft continued shaking violently, which terrified me.

(2) Daughter of the injured passenger

The Aircraft started to shake right after my mother left the lavatory despite the absence of bad shaking until then. A couple of seconds later, the Aircraft shook violently up and down two or three times as if we were on a roller coaster. The shaking was so strong that my bag, which was on the unoccupied seat next to me, fell on the floor.

A few minutes later, I started to worry about my mother not returning after such a long time, and so I went towards the lavatory in the aft section to check on her and found her seated in a seat in the aft cabin section. She had red bruises on her head, probably from hitting her head against an overhead luggage compartment, and she complained of pains in her abdomen likely caused when that part of her body hit against something hard, like a backrest or an armrest; she said she could not move. She said she had never before experienced such a severe shaking despite her frequent business trips to Beijing. That was the only strong shaking that occurred during the flight, and it lasted about five minutes, including some milder shaking. I do not remember if the seat belt sign was on but I do remember an announcement after the shaking telling us that we must fasten our seat belts.

The accident occurred at about 19:19 on February 10, 2008, at about 31,400 ft above Matsue City, Shimane Prefecture (35°30'N, 133°06'E).
(See Figure 1 Estimated Flight Route and Photo 2 The Aisle of the Aircraft)

2.2 Injuries to Person

One passenger was seriously injured.

2.3 Damage to the Aircraft

The Aircraft was not damaged.

2.4 Personnel Information

(1) PIC Male, Age 34

Airline Transport Pilot Certificate (Airplane)	
Type rating for Boeing 737	August 24, 2004
Class 1 Aviation Medical Certificate	
Validity	July 25, 2008
Total flight time	9,061 h 25 min
Flight time in the last 30 days	108 h 46 min
Total flight time on the type of aircraft	6,193 h 57 min
Flight time in the last 30 days	108 h 46 min

(2) Second PIC Male, Age 33

Airline Transport Pilot Certificate (Airplane)	
Type rating for Boeing 737	September 4, 2004
Class 1 Aviation Medical Certificate	
Validity	July 13, 2008
Total flight time	6,480 h 57 min
Flight time in the last 30 days	74 h 07 min
Total flight time on the type of aircraft	4,139 h 07 min
Flight time in the last 30 days	74 h 07 min

(3) Co-pilot Male, Age 29

Commercial Pilot Certificate (Airplane)	
Type rating for Boeing 737	September 13, 2004
Class 1 Aviation Medical Certificate	
Validity	August 1, 2008
Total flight time	3,052 h 14 min
Flight time in the last 30 days	81 h 15 min
Total flight time on the type of aircraft	1,823 h 40 min
Flight time in the last 30 days	81 h 15 min

2.5 Aircraft Information

2.5.1 Aircraft

Type	Boeing 737-300
Serial number	25507
Date of manufacture	April 19, 1993
Certificate of airworthiness	AC0554
Validity	September 12, 2008
Total flight time	37,247 h 09 min
Flight time since last periodical check (62A check)	35 h 52 min

(See Figure 2 Three Angle Views of Boeing 737-300 and Photo 1 The Aircraft)

2.5.2 Weight and Balance

When the accident occurred, the Aircraft's weight is estimated to have been 46,194 kg and center of gravity is estimated to have been 17.05% mean aerodynamic chord (MAC), both of which are estimated to have been within the allowable range (maximum takeoff weight of 61,234 kg, and 9.74 to 26.32% MAC corresponding to the weight at the time of the accident).

2.6 Meteorological Information

2.6.1 General Weather and Cloud Conditions

According to the Asia Pacific Surface Analysis Chart at 15:00 on the day of the accident, the northern area of western Japan was covered by a high-pressure that had its center in the central region of China, while a low-pressure with fronts was extending over the sea east of the main island of Japan. The relevant Satellite Cloud Information Chart did not include any information suggesting the presence of clouds above 12,000 ft over the Sea of Japan, the Chugoku region or the Kansai region of Japan.
(See Figure 5 Asia Pacific Surface Analysis Chart)

2.6.2 World Significant Weather Prognostic Chart

The Significant Weather Prognostic Chart valid at 15:00 on the day of the accident, which the PIC and other flight crewmembers received prior to the flight, showed a 180 knots jet stream zone at FL380, which stretched from China to Japan along the parallel of latitude that runs approximately 37 degrees north. It also showed a forecast zone of moderate or locally intensified CAT (Clear Air Turbulence) at FL280 – 350, which extended from 35 to 38 degrees north, a zone straddling the jet stream zone, and stretched from the 100 degrees east longitude line in China to South Korea including the Yellow Sea.
(See Figure 6 Significant Weather Prognostic Chart)

2.6.3 Significant Weather Analysis Charts

The Significant Weather Analysis Chart for users in Japan valid at 15:00 on the day of the accident showed a CAT zone at FL260 – 320 resulting from the great VWS (Vertical Wind Shear*6) accompanied by a jet stream front, which extended widthwise from 34 to 36 degrees north and stretched from the Yellow Sea to the Sea of Japan off Yamaguchi Prefecture via the southern part of South Korea. The analysis thereof expected the CAT zone to move eastward at 30 kt.

The Significant Weather Analysis Chart valid at 18:00 on the day of the accident showed a CAT zone at FL290 – 350 resulting from the great VWS accompanied by a jet stream front, which extended widthwise from 34 to 38 degrees parallel north and stretched from the Yellow Sea to the Sea of Japan off Shimane Prefecture via South Korea. The analysis thereof expected the CAT zone to

*6 Vertical wind shear is the difference in wind between the top and bottom layers converted into the difference per 1,000 ft, for the wind direction and velocity at locations obtained through wind analysis. It becomes larger as the change in wind direction or velocity, or both, become larger as the altitude increases. Vertical wind shear is also called "wind shear" for short.

move eastward at 30 kt.
(See Figure 7-1 Significant Weather Analysis Chart at 15:00 on Feb. 10, 2008 and Figure 7-2 Significant Weather Analysis Chart at 18:00 on Feb. 10, 2008)

2.6.4 Vertical Wind Shear Analysis Charts

The vertical wind shear analysis chart representing a vertical section along the 132.5 degrees east longitude line valid at 19:00 on the day of the accident, the vertical wind shear in the area where the accident occurred included a jet stream of 170 kt or faster in the air at FL380 – 350 and latitude near 35 degrees 30 minutes north, the point where the Aircraft encountered strong shaking, whereas the jet stream's velocity at FL310 was much lower, i.e., at 120 kt. That is, the vertical wind shear across FL330 – 310 was 12 – 15 kt/1,000 ft. The temperature at FL340 was about –35°C, whereas the isothermal curve for FL310 indicates a –40°C line extending from the north, showing that an inversion layer.

The vertical wind shear analysis chart representing a horizontal section at FL310 valid at 19:00 on the day of the accident shows isothermal lines extending at close intervals along the strong wind line , depicting the vertical wind shear was 12 kt/1,000 ft or greater extending eastward from the central part of China, covering the southern part of South Korea and reaching the Setouchi region of Japan.
(See Figure 8-1 Vertical Wind Shear Analysis Chart and Figure 8-2 Vertical Wind Shear Analysis Chart)

2.7 Information on DFDR and Cockpit Voice Recorder

The Aircraft was equipped with a DFDR (part number: 980-4100-DXUN) made by Sundstrand (now Honeywell) of the United States of America and a cockpit voice recorder (part number: 93-A100-80) made by Fairchild (now L-3 Communications) of the United States of America.

The DFDR retained data from the time the Aircraft departed Beijing Capital International Airport to the Aircraft arrived at Kansai International Airport. The cockpit voice recorder, capable of recording for a period of about 30 minutes, did not retain data for the time around the accident occurred because the data was overwritten.

The time was determined by correlating the DFDR recorded VHF transmission keying signals with the NTT (Nippon Telegraph and Corporation) speaking clock recorded on the ATC communication records.

2.8 Medical Information

When the Aircraft arrived at Kansai International Airport, an ambulance was already on standby at the apron. The injured passenger was taken to a hospital where she was diagnosed with peritonitis, requiring hospitalization for about 10 days of treatment.

2.9 Company's In-Cabin Procedures

2.9.1 The Company's Operations Manual includes the following descriptions.

9.19 Notice to Passengers (excerpts)

The signs like Fasten seat belts or No smoking shall be on at any motion made on the ground by the airplane, at each takeoff, landing or any time deemed necessary by the pilot-in-command. When the annunciators are on with signals of fasten seat belts, each passenger shall fasten their seat belts in their seats and keep on fastening.

When the annunciators giving the signal of Fasten seat belts at a time when turbulence is possibly encountered, it is applicable to all flight crew members and all passengers. The flight attendant shall secure all loose apparatuses in the cabins to ensure that the seat belts of all passengers, including those sleeping passengers who occupy two or three seats, are fastened properly

.

2.9.2 The Company's Flight Attendants Manual includes the following descriptions.

2.3.23 Turbulence

(1) After "Fasten Seat Belt" sign is on, make an announcement and check the passengers to fasten their seat belts, when there is turbulence.

(2) The captain will determine the level of turbulence and advise the chief purser/purser.

(3) When there is slight turbulence, continue to cabin service but do not serve hot beverages to prevent passenger from accidental scalding.

(4) When there is a moderate turbulence, suspend the cabin service, and store all their foodstuff properly.

(5) When there is sudden severe turbulence, suspend the cabin service, and step on the stopper at once. Sit on nearest seat and fasten seat belts.

(NOTE: "stopper" in (5) means brake on food/beverage cart.)

2.10 A/P Disengagement

With regard to the conditions for A/P disengagement due to turbulence, the result of the investigation undertaken by the adviser of the United States of America, the State of Design and Manufacture of the Aircraft, showed that there was no factual information in the data from the Aircraft's DFDR to indicate what caused disengagement of the A/P. The investigation also ascertained that the Aircraft's A/P does not automatically disengage because of turbulence, whereas the advisor, in response to the question about conditions for A/P disengagement, suggested the possibility of A/P disengagement caused by the loss of valid signals or intermittent contact on switches or relays during shaking.

The Boeing 737 Flight Crew Operations Manual includes the following descriptions.

The A/P automatically disengages when any of the following occurs:

- *Pushing either A/P disengage switch*
- *Pushing either Takeoff/Go-around (TO/GA) switch with a single A/P engaged in CWS or CMD below 2000 feet RA*
- *Pushing either TO/GA switch after touchdown with both A/Ps engaged in CMD*
- *Pushing a lighted A/P engage switch, pushing the A/P disengage bar down (if equipped with a button type A/P control) or moving the A/P engage lever to OFF (if equipped with a*

lever type A/P control).

- *Activating either pilot's control wheel trim switch*
- *Moving the STAB TRIM AUTOPILOT cutout switch to CUTOUT*
- *Loss of respective hydraulic system pressure*
- *Repositioning the EFI transfer switch*
- *Either left or right IRS system failure or FAULT light illuminated*
- *Loss of electrical power or a sensor input which prevents proper operation of the engaged A/P and mode*

NOTE: Loss of the system A engine-driven hydraulic pump and a heavy demand on system A may cause A/P A to disengage.

(See Figure 4 A/P Disengage Switch)

2.11 Tracks of Other Traffic on Radar Records

The radar track records of the Tokyo ACC did not include any tracks of aircraft whose wake turbulence might have affected the Aircraft.

2.12 Radio Communication with the Operations Support Contractor

According to the staff in charge of radio communications of the Company's operations support service contractor at Kansai International Airport, a message was received from the Aircraft at about 19:40 on the day of the accident asking to have an ambulance ready for a passenger who had been injured as a result of turbulence, and the staff made the necessary arrangements. The staff then asked about the turbulence and other detailed information, but there was no response from the Aircraft.

3. ANALYSIS

3.1 The PIC, the Second PIC and the Co-Pilot held both valid airman competency certificates and valid aviation medical certificates.

3.2 The Aircraft had a valid airworthiness certificate and had been maintained and inspected as prescribed.

3.3 Situations in the Cabin

As described in 2.1.2 and 2.1.3, situations in the cabin are as follows:

The seat belt sign remained on throughout the flight, but there was only mild shaking until the Aircraft started its descent. Therefore it is considered highly probable that the passengers were not informed by the CP and FA about restrictions on leaving their seat as stipulated in the Company's Operations Manual regarding the requirement for passengers to keep their seat belt fastened.

It is considered probable that when the Aircraft began to shake soon after the start of descent, an FA, in her attempt to encourage the two passengers who had left their seats for using the lavatory to seat themselves and fasten seat belts, helped one of them into a seat but strong shaking occurred before she could tell the other passenger to sit in a seat.

It is considered highly probable that the latter passenger who was walking in the aisle from the lavatory back to her seat lost her balance due to the shaking, hitting her abdomen hard against a part of a nearby seat and thus sustaining serious injury.

3.4 Shaking Experienced by the Aircraft

Shaking experienced by the Aircraft based on DFDR are as follows:

(1) The Aircraft began descending from a cruising altitude of FL330 at about 19:18:13 with the A/P engaged. At about 19:19:04, when the Aircraft was at a pressure altitude of about 31,500 ft, the CAS increase rapidly from about 270 kt to 285 kt, in response to which the A/P moved the control column to pull up the nose as an automatic control action against this quick change in CAS. At about 19:19:06, i.e., when the Aircraft began to pitch upwards, the A/P disengaged. There was no factual information in the data from the Aircraft's DFDR to indicate what caused the disengagement of the A/P.

The cause of A/P disengagement, therefore, could not be determined, although it is considered possible that a loss of valid signals or intermittent contact on switches or relays might have occurred as suggested in the response from the adviser of the United States of America, the State of Design and Manufacture of the Aircraft, as described in 2.10, or the Second PIC might have unconsciously pushed the A/P disengage switch on the control wheel.

(2) After disengagement of the A/P while the Aircraft's pitch-up attitude had begun to increase, the Second PIC executed manual control to continue bringing the nose up in order to decrease the CAS. When the CAS stopped increasing, the Second PIC moved the control column forward by a fairly large amount to bring the nose down, and

immediately after this, he moved the column aft, also by a large amount. Following these control column movements, the Aircraft's pitch angle changed upward, then significantly downward, and again upward. The vertical acceleration thus showed these large changes during the period from 19:19:08 to 19:19:11, i.e., having changed positively to about 2.2G, the maximum value during the flight, then changing negatively to about 0.0G, the minimum value during the flight, and again changing positively to about 2.0G.

This wide fluctuation in vertical acceleration took place 55 seconds after the Aircraft began descending. Since there were no significantly large fluctuations in vertical, lateral or longitudinal acceleration in the DFDR data for any other time from takeoff to landing, it is considered highly probable that the injured passenger lost one's balance due to this distinctively large fluctuation in vertical acceleration.

3.5 Influence of Weather

As supported by the CAT zone forecast on the Significant Weather Prognostic Chart checked by the PIC and the Second PIC prior to the flight and by the Significant Weather Analysis Charts valid at 15:00 and 18:00 on the day of the accident, as described in 2.6.2 and 2.6.3, it is considered highly probable that a CAT zone was moving eastward while widening in latitudinal direction, and the point of occurrence of the accident was in the area of the CAT zone at the time of the accident.

The vertical wind shear analysis charts described in 2.6.4 show a jet stream in the area above the point where the accident occurred; a strong wind of 180 kt was prevailing at FL380 and there was significant variation in wind velocity as represented by closely spaced isotachs in the area down to FL310, in addition to narrowly spaced isothermal lines extending along the strong wind line, which was bordered by a jet stream front extending from west to east. It is considered probable that vertical wind shear of 12 kt/1,000 ft or greater existed in the area of occurrence of the accident as well as an inversion layer as expected by the analytical data included in the charts.

The DFDR data indicates a rapid decrease in wind velocity during the period from slightly before A/P disengagement to immediately after disengagement, but the indicated vertical acceleration variation is rather slight for the period before disengagement. It is therefore considered highly probable that the vertical wind shear had almost no impact on the Aircraft.

As described in 3.4 (2), the vertical acceleration fluctuated wildly following the control column movements after A/P disengagement. It is considered possible that vertical wind shear might have contributed to this fluctuation.

3.6 Wake Turbulence of Other Traffic

Based on the other traffic's tracks on the Tokyo ACC radar track records described in 2.11, it is considered highly probable that the Aircraft was not affected by wake turbulence of other aircraft.

3.7 Sharing of Weather Information

As described in 2.1.2(1),(2) and 2.12, the flight crew asked the Company's operations support service contractor at Kansai International Airport to have an ambulance ready for the passenger

injured in the turbulence, but they neither provided the information on the turbulence to the contractor nor reported it to the ATC.

The PIREP (pilot report) on significant weather actually encountered by an aircraft is a useful source of information that can contribute to the safety of subsequent aircraft flying in the reported area by allowing the pilots to select a safe altitude and route.

It is desirable that pilots actively share and use the PIREP regarding significant weather by promptly reporting the experienced conditions to ATC and other appropriate organizations.

4. PROBABLE CAUSE

It is considered highly probable that the accident occurred as follows: While the Aircraft was making its landing descent in an area involving vertical wind shear, the Aircraft was shaken due to the partially excessive control inputs executed by the Second PIC that followed the disengagement of the A/P. Therefore, the passenger who was walking in the aisle at that time lost her balance and strongly hit her abdomen against an object, resulting in a serious injury.

Figure 1　Estimated Flight Route

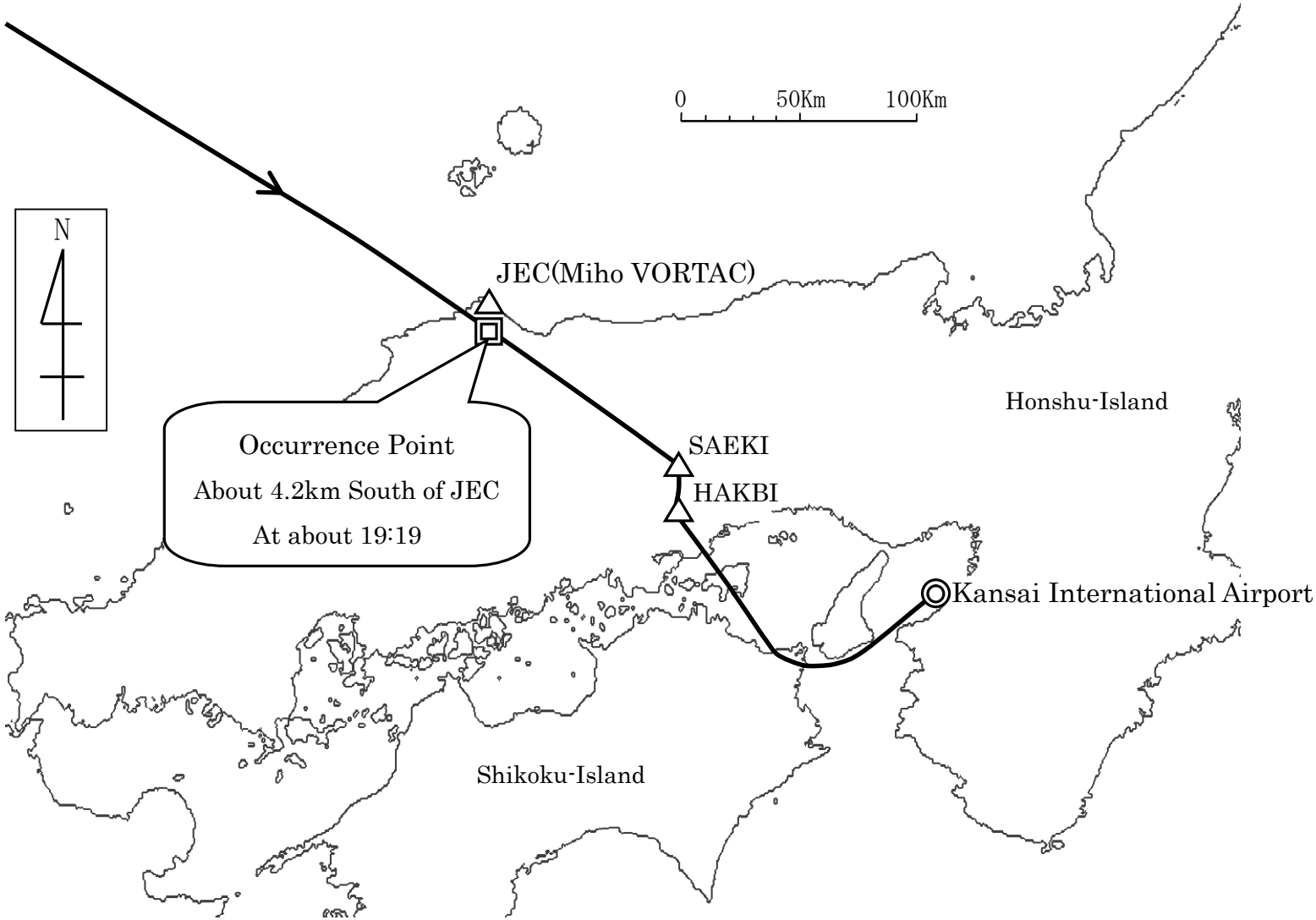


Figure 2　Three Angle Views of Boeing 737-300

unit：m

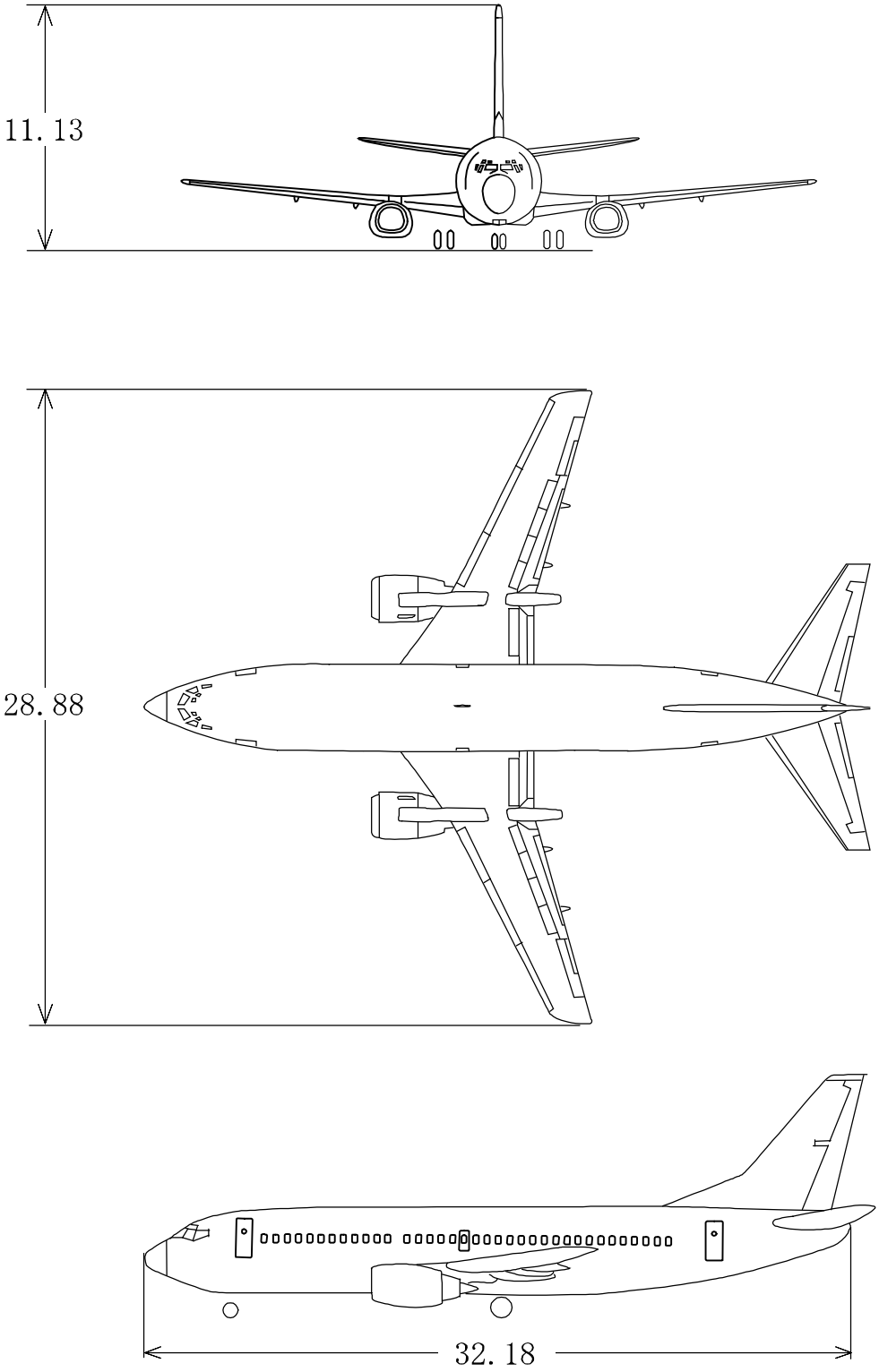


Figure 3　DFDR Records

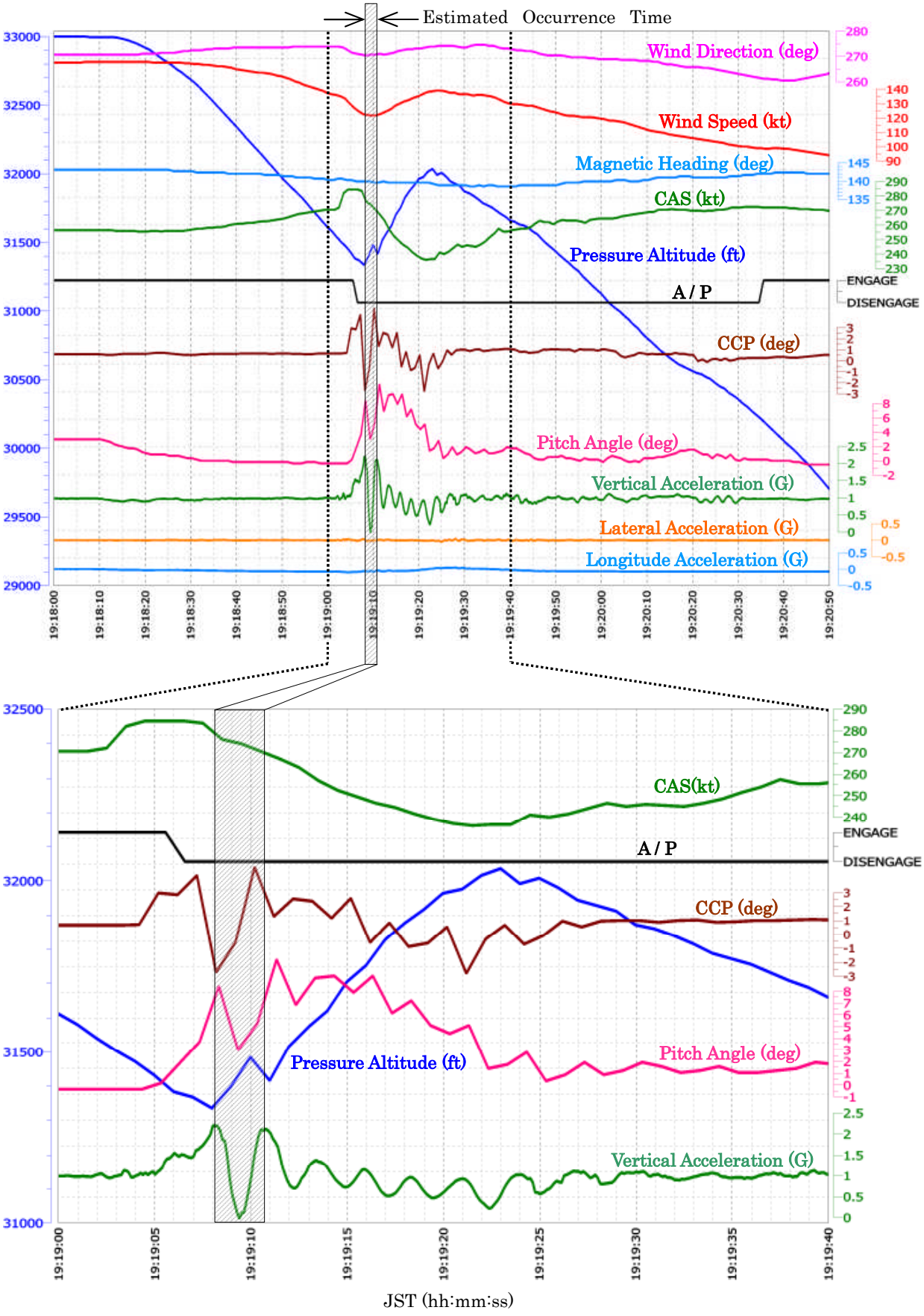
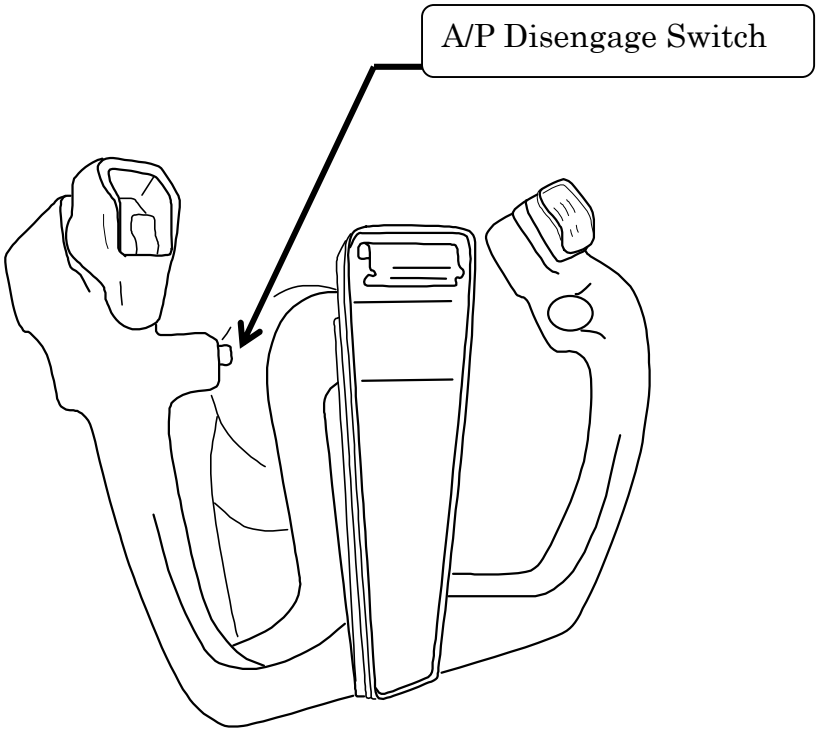


Figure 4　A / P Disengage Switch



Control Wheel of Left Seat

Figure 5 Asia Pacific Surface Analysis Chart

at 15:00 on Feb. 10, 2008

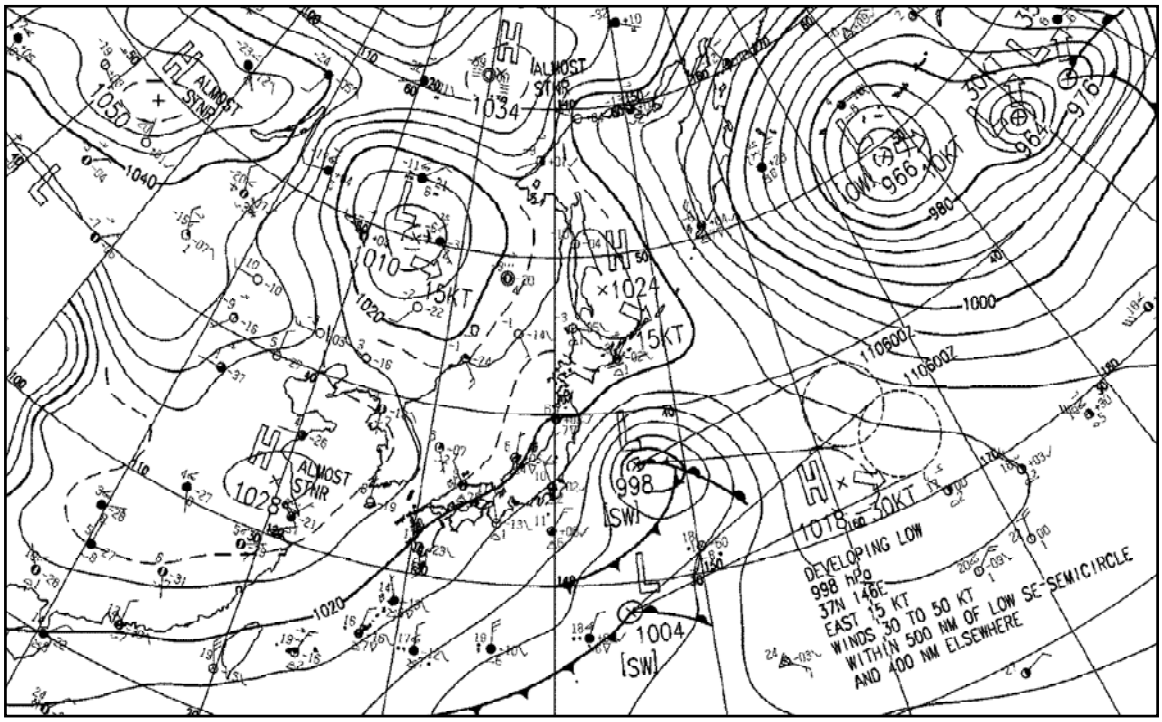


Figure 6 Significant Weather Prognostic Chart

at 15:00 on Feb. 10, 2008

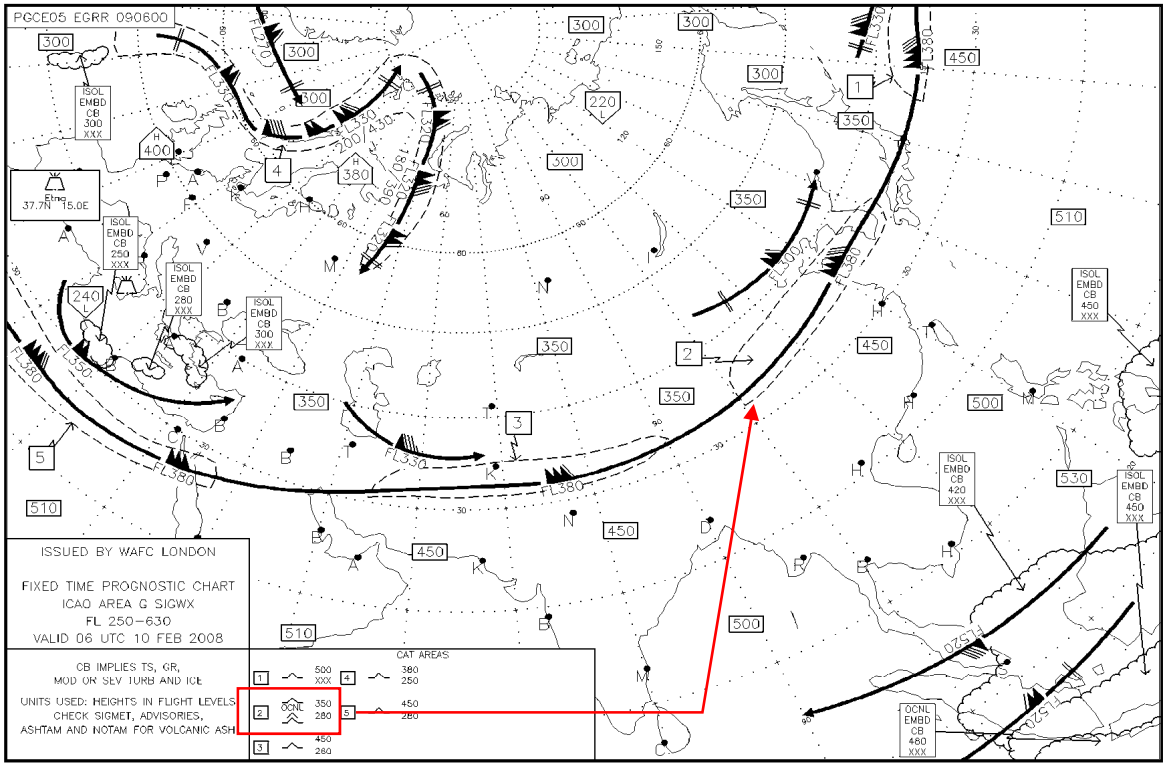


Figure 7-1　Significant Weather Analysis Chart　at 15:00 on Feb.10, 2008

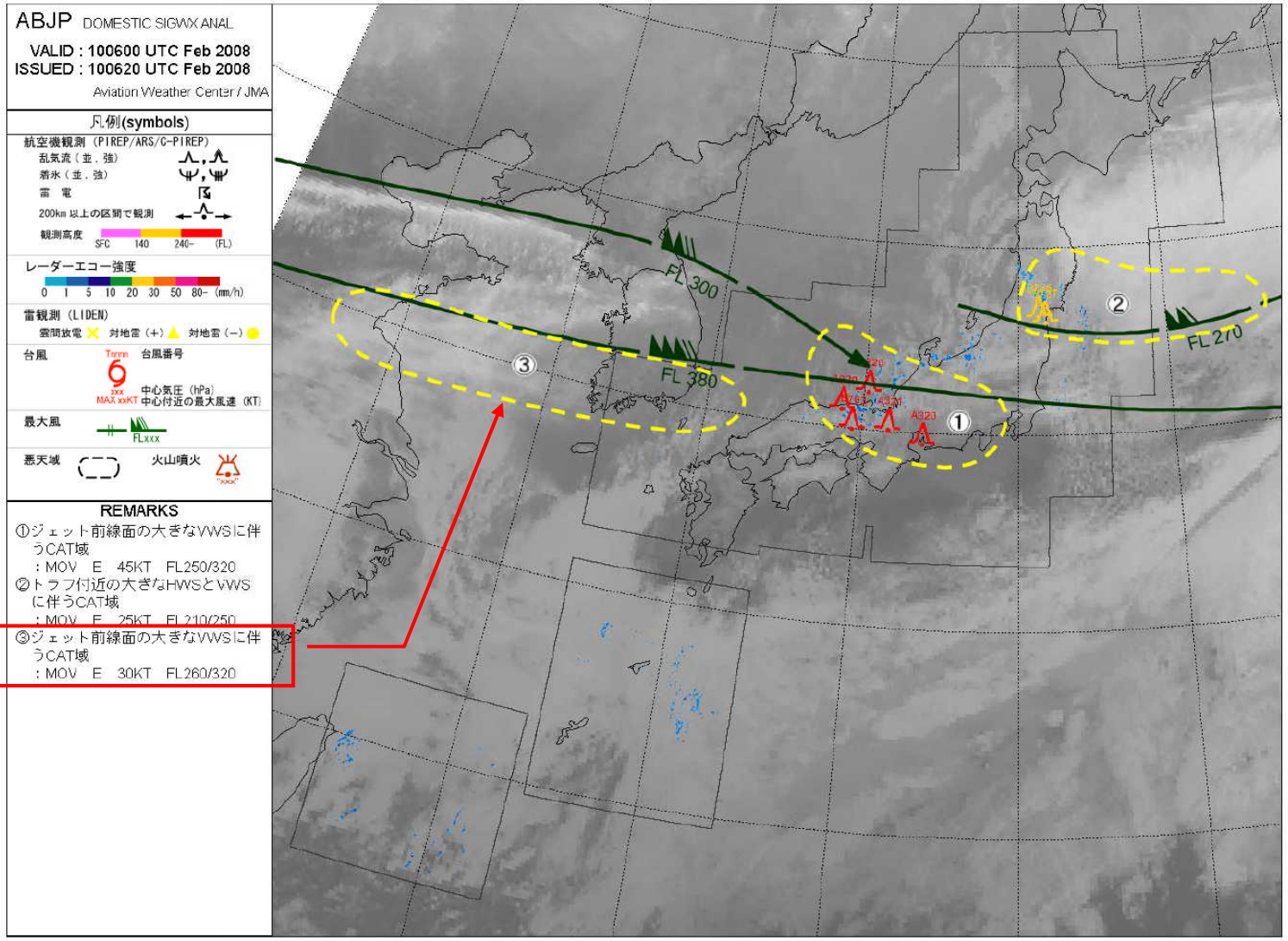


Figure 7-2　Significant Weather Analysis Chart　at 18:00 on Feb.10, 2008

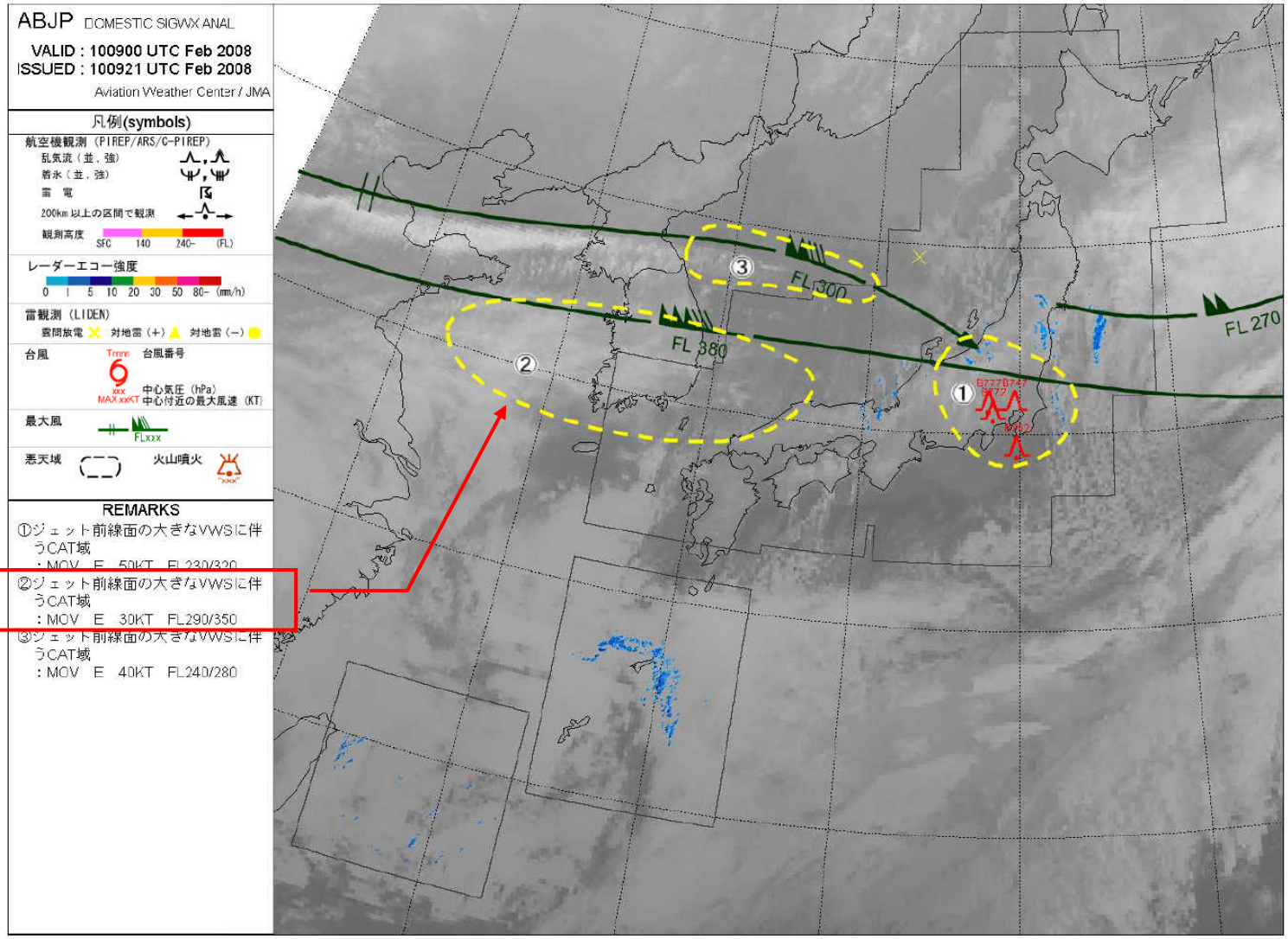


Figure 8-1　Vertical Wind Shear Analysis Chart

132.5E Vertical Section at 19:00 on Feb. 10, 2008

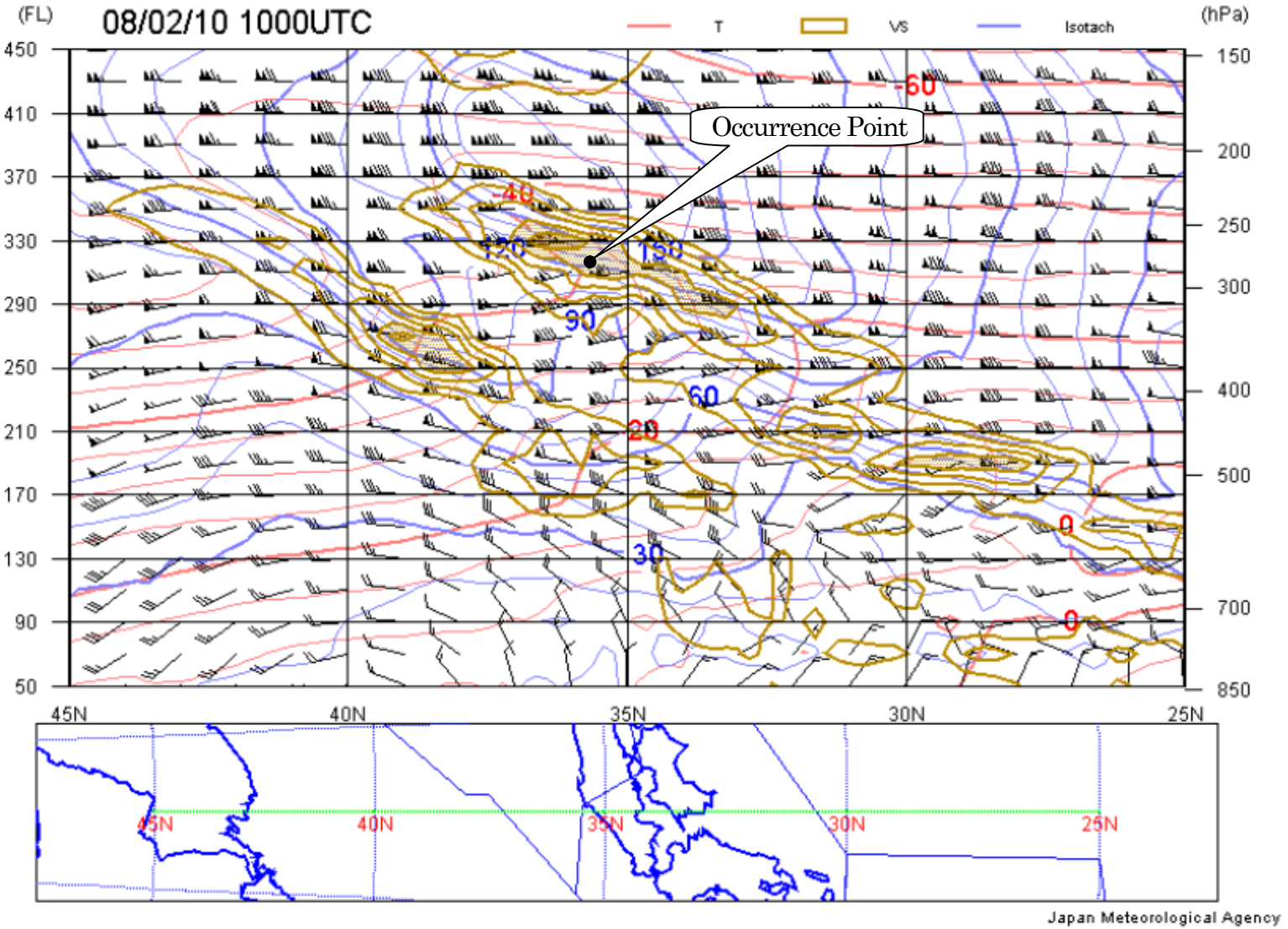


Figure 8-2　Vertical Wind Shear Analysis Chart

FL310 Horizontal Section at 19:00 on Feb. 10, 2008

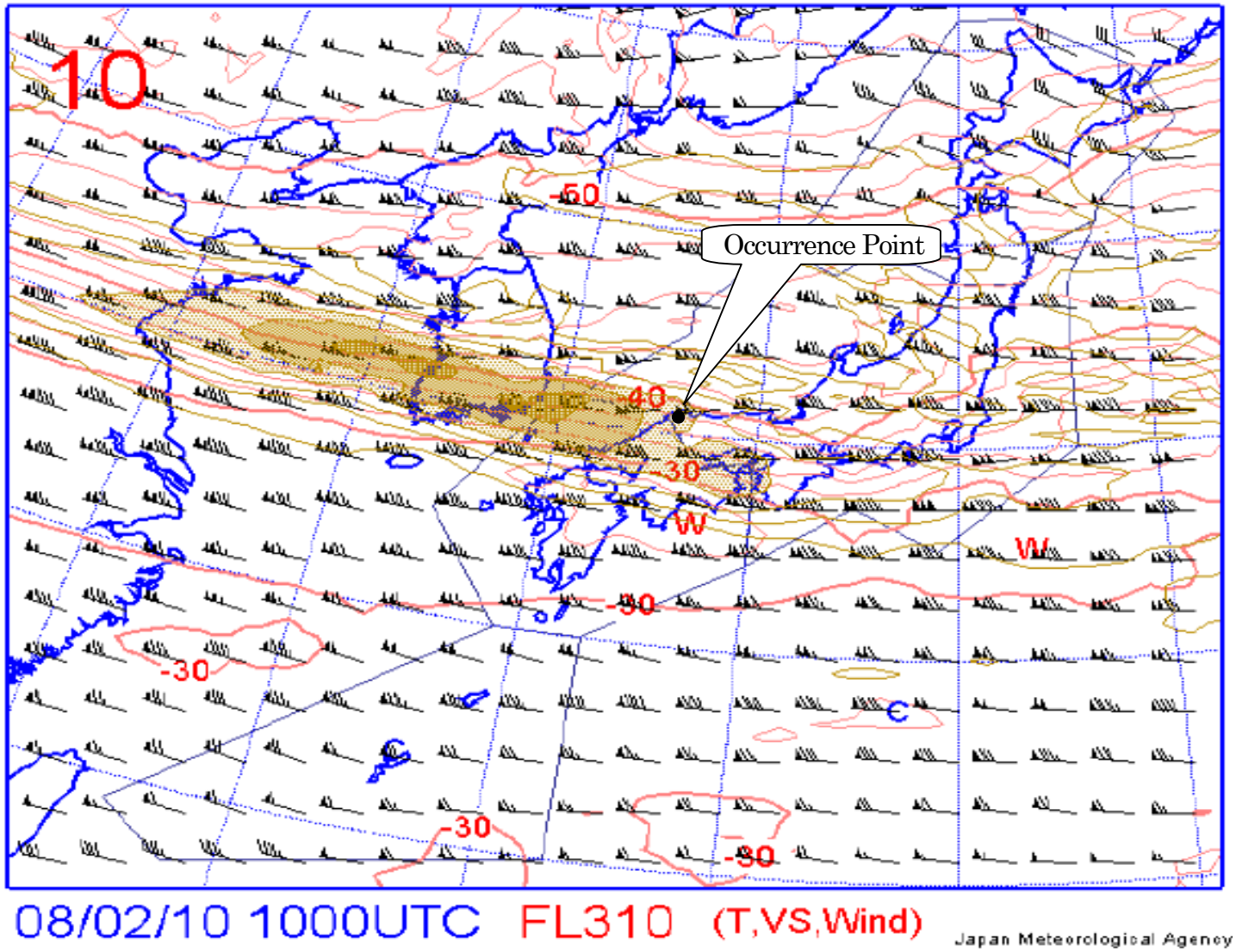


Photo 1　The Aircraft

Photo 2　The Aisle of the Aircraft

(Viewed from aft to forward)