Final Report

A350-900, REGISTRATION 9V-SMB

TURBULENCE EVENT

27 June 2025

TIB/AAI/CAS.251

Transport Safety Investigation Bureau
Ministry of Transport
Singapore

23 June 2026

The Transport Safety Investigation Bureau of Singapore

The Transport Safety Investigation Bureau of Singapore (TSIB) is the air, marine and rail accidents and incidents investigation authority in Singapore. Its mission is to promote transport safety through the conduct of independent investigations into air, marine and rail accidents and incidents.

The TSIB conducts air safety investigations in accordance with the Singapore Transport Safety Investigations Act 2018, Transport Safety Investigations (Aviation Occurrences) Regulations 2023 and Annex 13 to the Convention on International Civil Aviation, which governs how member States of the International Civil Aviation Organization (ICAO) conduct aircraft accident investigations internationally.

The sole objective of TSIB's air safety investigations is the prevention of aviation accidents and incidents. The safety investigations do not seek to apportion blame or liability. Accordingly, TSIB reports should not be used to assign blame or determine liability.

Table of Contents

ABBREVIATIONS

ATC	Air Traffic Control
CAVOK	Ceiling And Visibility OK
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
FCTM	Flight Crew Techniques Manual
FCU	Flight Control Unit
FIR	Flight Information Region
FL	Flight Level
G	Gravitational Force
NM	Nautical Mile
ND	Navigation Display
PA	Public Address
PF	Pilot Flying
PM	Pilot Monitoring
PIC	Pilot-in-Command
PVG	Shanghai Pudong International Airport
RDCA	Rapidly Developing Cumulus Area
STAR	Standard Terminal Arrival Route
TAF	Terminal Aerodrome Forecast
WXR	Weather Radar

SYNOPSIS

On 27 June 2025, an Airbus A350-900 passenger flight from Singapore to Shanghai Pudong International Airport, China, encountered turbulence at around 27,000 feet as it was descending to Shanghai. A cabin crew member sustained serious injuries.

The Transport Safety Investigation Bureau of Singapore classified this occurrence as an accident.

AIRCRAFT DETAILS

Aircraft type	:	Airbus A350-900
Operator	:	Singapore Airlines
Aircraft registration	:	9V-SMB
Date and time of incident	:	27 June 2025 at 0918 UTC
Location of occurrence	:	At approximately 27,000 feet on approach to Shanghai Pudong International Airport
Type of flight	:	Scheduled
Persons on board	:	171 passengers and 14 crew members

1 FACTUAL INFORMATION

All times used in this report are Coordinated Universal Time (UTC) unless otherwise stated.

1.1 History of the flight

1.1.1 On 27 June 2025, an Airbus A350-900 aircraft operated a scheduled flight from Changi Airport, Singapore to Shanghai Pudong International Airport (PVG), Shanghai, China. The flight crew comprised a Pilot-in-Command (PIC) and a First Officer (FO). The PIC was the Pilot Flying (PF) and the FO the Pilot Monitoring (PM).

1.1.2 The PIC and the FO reviewed the pre-flight briefing package prepared by the flight dispatcher for the flight to Shanghai, which included a forecast of occasional cumulonimbus[1] clouds enroute. The weather in the vicinity of PVG was Ceiling And Visibility OK[2] (CAVOK) at the time of arrival. Similarly, the Terminal Aerodrome Forecast[3] (TAF) did not indicate any weather of concern at the time of arrival. Mindful that traffic conditions on this route could be unpredictable and could result in delays, the PIC requested for an additional 1.5 tonnes of fuel to be uplifted, which would give them an extra 15 minutes of holding time.

1.1.3 The aircraft took off at about 0450hrs. According to the flight crew, during the cruise phase, they made a few minor deviations to avoid weather patches and switched on the fasten-seat-belt signs as and when required. Otherwise, the cruise phase was uneventful.

1.1.4 At about 0911hrs, when the aircraft was in the Shanghai Flight Information Region (FIR), it was instructed by Shanghai Radar Control to descend from its cruise altitude of 12,500m (41,000 feet, i.e. FL[4]410). The cabin crew were preparing the aircraft for arrival and securing the cabin for landing. The fasten-seat-belt signs were switched on and the flight crew made a Public Address

[1] Occasional cumulonimbus describes a weather condition with isolated, well-separated cumulonimbus clouds that cover between 50% and 75% of the area.
[2] CAVOK indicates favourable weather conditions for flight where the visibility is 10km or more, no cloud below 5,000 feet (or above the minimum sector altitude), absence of significant weather such as thunderstorms and no cumulonimbus or towering cumulus clouds.
[3] A TAF provides forecasted weather conditions at or near a specific airport, usually covering a radius of about 5 nautical miles around the airfield.
[4] Flight level.

(PA) announcement for the passengers to be seated even though the flight was smooth at this point. The PA announcement did not require the cabin crew to be seated and they could continue with cabin duties.

1.1.5 According to the flight crew, prior to the top of descent, the weather radar (WXR) display did not show any weather returns. The flight crew recalled that shortly after commencing descent, the WXR display started to show red and yellow[5] returns. They looked out of the cockpit and saw widespread weather ahead with a clear path between two weather cells and the weather beyond this path appeared to be clear. The PIC decided that there was no need to divert to an alternate aerodrome as the latest Automatic Terminal Information Service (ATIS) indicated that the weather over PVG was still good.

1.1.6 The PIC was anticipating being assigned a Standard Terminal Arrival Route[6] (STAR) and noted that the left weather cell was in the path of the STAR. The distance between the nearest edges of the two weather cells, as estimated from the WXR displays, was about 20NM. He decided to navigate the aircraft through the clear path between the two weather cells by making heading adjustments (see **Figure** 1 in paragraph 1.6.2.1). He did not wish to circumvent the left and right weather cells given that:

(a) the extent of the left weather cell was significant and circumnavigating it by going left of this weather cell would require extensive deviation; and

(b) circumventing the right weather cell would bring the aircraft to or even beyond the boundary of the Shanghai FIR.

1.1.7 The FO agreed with the PIC's decision.

1.1.8 The flight crew recalled that as the aircraft was descending past FL310 (approximately 9,500m), they entered a layer of cloud. They were no longer able to have visual sight of the weather cells outside and relied on the WXR to monitor the weather condition and locations of the weather cells. The pilots reduced the range setting on their navigation displays (NDs) from 80NM and toggled between the 10, 20 and 40NM settings to obtain more precise representations of the weather conditions displayed on their NDs. This was in

[5] Yellow indicates moderate precipitation and red indicates heavy precipitation.

[6] A Standard Terminal Arrival Route is a published Instrument Flight Rules (IFR) air traffic service procedure used by flight crew to transition from enroute phase to the initial approach phase at a destination airport.

line with the procedures recommended in the Flight Crew Techniques Manual (FCTM) which state that the accuracy of the weather echo is better for weather closer to an aircraft when the ND is at shorter range settings.

1.1.9 At about 0913hrs, the flight crew requested air traffic control (ATC) for a heading change from 060 to 065. The request was approved. The heading change was to navigate the aircraft to the clear area between the two weather cells. At that point, the aircraft was approximately 132NM from PVG.

1.1.10 According to the flight crew, as the aircraft exited the layer of cloud, they immediately saw that the left weather cell was very close on their left. It was a tall cumulonimbus cloud where the cloud top and base could not be seen. The PIC immediately instructed the FO to request for a heading change from 065 to 080 as he assessed that the priority was to stay clear of the left weather cell. The transmission to ATC for the heading change was made at about 0918hrs. At the same time, the PIC decided that it was necessary to initiate the heading change on the autopilot flight control unit (FCU) without delay, even before ATC approved the heading change.

1.1.11 Approximately 5 seconds after making the request to ATC for the heading change, the aircraft encountered turbulence when it was descending through 27,500 feet. Data from the digital flight data recorder (DFDR) showed that the vertical acceleration decreased from +1G[7] to +0.66G in 2 seconds, then increased to +1.78G in 1.5 seconds. Over the next 0.75 seconds, the vertical acceleration decreased to -0.02G before increasing to a peak value of +2.63G. The aircraft returned to stable flight after about another 5 seconds. Throughout the turbulence encounter, the autopilot remained engaged and provided inputs to correct for the aircraft attitude changes. From the commencement of descent to just prior to the turbulence encounter, the DFDR data did not indicate any significant vertical acceleration variation. The flight and cabin crews' recollections were consistent with what the DFDR indicated.

1.1.12 Immediately after the turbulence encounter, the PIC contacted the inflight manager, requesting for updates of any injuries to the cabin occupants. The inflight manger checked and found that several cabin crew members had become airborne momentarily during the turbulence encounter. Two of them had been more seriously affected than the rest and were relived of their duties

[7] Gravitational force (G) is a measure of acceleration that compares the force experienced by the aircraft with the force corresponding to the acceleration due to gravity.

and remained seated for the remainder of the flight. The two cabin crew members did not ask for immediate medical attention as they felt that they could manage themselves until the aircraft landed.

1.1.13 At about 0922hrs, the flight crew informed ATC that they were clear of weather. The aircraft landed at about 1017hrs without further incident. After the aircraft was parked, the inflight manager informed the PIC that some of the cabin crew members had sustained injuries. Cabin crew members who felt discomfort or unwell were provided with medical attention. Among the two cabin crew members who were mentioned in paragraph 1.1.12, one was diagnosed with left ankle fracture[8] while the other was given outpatient treatment along with the rest of the cabin crew.

1.2 Injuries to persons

Injuries	Flight Crew	Cabin Crew	Passengers	Total
Fatal	0	0	0	0
Serious	0	1	0	1
Minor	0	5	0	5
Uninjured	2	6	171	179
Total	2	12	171	185

1.3 Damage to aircraft

1.3.1 There was no damage to the aircraft.

1.4 Personnel information

1.4.1 PIC

Age	51
Licence type	Airline Transport Pilot Licence
Issuing authority	Civil Aviation Authority of Singapore
Licence validity date	Valid till 30 April 2026
Medical certificate	Class 1

[8] This cabin crew member was in the aft galley packing away a tray of drinks in preparation for arrival. After the turbulence encounter, he was able to finish tidying the galley before sitting down at his allocated position for the rest of the flight.

Medical certificate validity	Valid till 30 April 2026
Medical operational proviso	Nil
Last Base Check date	15 June 2025
Last Line Check date	17 October 2024
Total flying hours	14,000 hours
Aircraft types flown	Airbus A350, A380, Boeing B777
Total hours on type	5,500 hours
Flying in last 90 days	160 hours
Flying in last 7 days	0 hour
Flying in last 24 hours	0 hour
Duty time in last 48 hours	0 hour
Rest period in last 48 hours	48 hours

1.4.2 FO

Age	34
Licence type	Multi-Crew Pilot Licence
Issuing authority	Civil Aviation Authority of Singapore
Licence validity date	Valid till 31 October 2025
Medical certificate	Class 1
Medical certificate validity	Valid till 31 October 2025
Medical operational proviso	Holder shall wear corrective lenses that correct for distant vision and shall have available a second pair of spectacles whilst exercising the privileges of the license
Last Base Check date	5 April 2025
Last Line Check date	20 March 2025
Total flying hours	1,512 hours 30 minutes
Aircraft types flown	Airbus A350
Total hours on type	1,512 hours 30 minutes
Flying in last 90 days	277 hours 42 minutes
Flying in last 7 days	12 hours 34 minutes
Flying in last 24 hours	0 hour
Duty time in last 48 hours	0 hour
Rest period in last 48 hours	48 hours

1.5 Aircraft information

1.5.1 Weather radar (WXR) system

1.5.1.1 No WXR faults were reported for the flight prior to the occurrence flight. There is no evidence that the WXR was not working normally during the occurrence flight.

1.5.1.2 The weather radar does not detect all clouds within its field of view. The weather radar only detects moisture within convective cloud. What is displayed on the ND may not be the extent of the cloud but the area with moisture within its detectable range, see paragraph 1.8.1.5.

1.6 Meteorological information

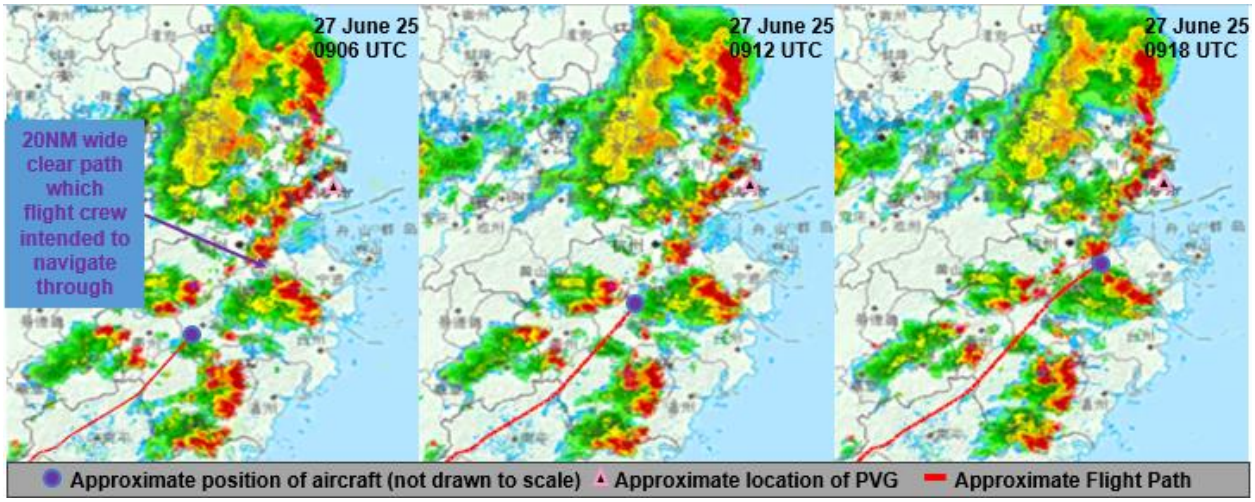
1.6.1 Pre-flight briefing package

1.6.1.1 The flight dispatch package indicated CAVOK for the weather in the vicinity of PVG and the TAF did not indicate any forecasted weather of concern. The enroute weather information indicated that occasional cumulonimbus clouds were forecasted in the vicinity where the turbulence encounter occurred.

1.6.2 Recorded Weather Data

1.6.2.1 Figure 1 is a series of ground weather radar images, shared by the China Meteorological Service and taken at 0906hrs, 0912hrs and 0918hrs[9]. The images show weather cells to the left and right of the aircraft and also a path with clear weather in the vicinity of PVG.

[9] The ground weather radar images were recorded six minutes apart.



(Source: China Meteorological Service) (Annotated: TSIB)

Figure 1: Ground weather radar images captured at 6-minute interval

1.7 Flight recorders

1.7.1 The DFDR and Cockpit Voice Recorder (CVR) were removed from the aircraft after it had completed the return sector from PVG to Singapore. The CVR data around the time of the turbulence occurrence had been overwritten. Data from the DFDR around the time of the turbulence occurrence was available for analysis.

1.8 Additional Information

1.8.1 Operations in Convective Weather

1.8.1.1 The operator's guidance to pilots flying in areas of convective weather is contained within the operator's FCTM. The FCTM provides pilots with practical guidance on how to operate the A350 aircraft.

1.8.1.2 The aircraft is installed with an onboard WXR system to help the flight crew identify and, if necessary, avoid areas of convective clouds and/or turbulence. The detected external weather condition is displayed on the NDs. The PF and PM can independently manage their own weather displayed on their NDs. The FCTM recommends that flight crew should use two different ranges on the PF and PM NDs to provide enhanced awareness on the situation. When using a low ND range setting, the information displayed on the ND will be more precise

and can help with a detailed analysis of the external weather conditions. According to both the PF and PM, they were aware that when operating near or in regions where the WXR detects weather, they should set the ND range to 80NM or less for more precise representation of external weather conditions.

1.8.1.3 The FCTM also recommended that the flight crew should, when using the WXR display, establish an “area of greatest threat” based on the location and shape of the strongest weather returns and the meteorological knowledge of the flight crew.

1.8.1.4 The recommended convective weather avoidance techniques stated in the FCTM are:

(a) If possible, perform lateral avoidance instead of vertical avoidance. Vertical avoidance is in general not recommended, particularly at high altitude, due to the reduction of buffet and performance margins. In addition, some convective clouds may have a significant and unpredictable build-up speed.

(b) Lateral avoidance:

(i) If possible, deviate upwind instead of downwind. Usually, there is less turbulence and hail upwind of a convective cloud

(ii) If possible, avoid the identified “area of greatest threat” by at least 20NM

(iii) Apply an additional margin if the convective clouds are very dynamic.

(c) Vertical avoidance:

(i) Avoid flying below a convective cloud, even in visual conditions, due to possible severe turbulence, windshear, microbursts, lightning strikes and hail. If an aircraft must fly below a convective cloud, the flight crew should take into account all indications (visual judgement, weather radar, weather report, pilot’s report, etc.) before they take the final decision.

(ii) For flight above a convective cloud, apply a vertical margin of 5,000 feet from the identified “area of greatest threat”.

1.8.1.5 One of the known limitations of the WXR is “shadowing” or “attenuation”[10]. WXR detection is based on the reflectivity of water droplets. The weather return appears on the ND with a colour scale that ranges from red to green[11]. The weather returns vary in intensity as a function of the droplet size, composition and quantity of precipitation. The weather returns displayed on the ND depends on signal returns: the more intense the precipitation, the less distance the radar can see through. Therefore, when the weather return is unable to make the two-way trip through heavy precipitation, a ‘shadowing’ effect occurs, meaning that weather behind shadowing cells may not be detected or may not be detected accurately. The result is twofold. First, the size, shape and intensity of that precipitation may not be accurately displayed to the pilot. What appears to be a thin or inexistent band of precipitation could in fact be the leading edge of a much larger area of precipitation. Second, any weather behind such strong shadowing cells will not be detected. This can result in unexpected weather unfolding only after the cell has been navigated.

1.8.2 Secure Cabin Procedure

1.8.2.1 The turbulence management framework issued by the operator to its flight staff was dated 11 March 2025. It contained the Secure Cabin Procedure (SCP) that was developed and implemented as an additional risk mitigation measure for airports with topographical and significant seasonal weather activity-related turbulence challenges.

1.8.2.2 The procedure is classified as SCP or non-SCP sectors and the applicable procedure is dependent on specific route that each aircraft is operating. For the event flight, it is classified as a non-SCP sector and the requirements are:

(a) By the time the aircraft descends past 20,000 feet, the fasten-seat-belt signs must be switched on to instruct the passengers to be seated with their seat belts fastened. The flight crew should make the announcement “Cabin crew secure cabin for landing”. This announcement is an instruction for the cabin crew to perform the following:

[10] Refer to Airbus publication on Optimum use of weather radar available here: https://safetyfirst.airbus.com/optimum-use-of-weather-radar/

[11] Red indicates the most intense reflectivity while green indicates low reflectivity.

(i) If possible, deviate upwind instead of downwind. Usually, there is less turbulence and hail upwind of a convective cloud

(ii) Ensure all hand carry baggage are properly stowed

(iii) Check that all passengers are seated with their seat belts fastened

(iv) All window shades are kept open and meal tables are stowed

(v) Ensure that all objects in the galley are properly secured

(b) By the time the aircraft descends past 5,000 feet, the flight crew should make the announcement “Cabin crew to your landing stations”. This announcement is an instruction for the cabin crew to be seated and with their seat belts fastened.

1.8.2.3 Additionally, the SCP allows the following:

(a) The PIC may exercise discretion any time during a flight to switch on the fasten-seat-belt signs earlier and instruct the cabin crew to suspend service and be seated if deemed necessary due to safety considerations.

(b) The cabin crew may also suspend service at any time, if deemed necessary due to safety considerations.

2 ANALYSIS

2.1 As the aircraft commenced its descent, the detected widespread weather returns became a concern to the flight crew as the left weather cell was in the path of the most likely STAR if ATC had wished to assign the STAR. The flight crew assessed this weather cell and the weather cell to the right of the aircraft's flight path as "areas of greatest threat". The PIC considered that circumnavigating the left weather cell would require extensive deviation while circumventing the right weather cell might bring the aircraft beyond the boundary of the Shanghai FIR. Thus, they decided to navigate through an approximately 20NM wide clear path between the left and right weather cells to reach PVG.

2.2 The convective weather avoidance techniques stated in the FCTM recommended that any deviation should be performed upwind instead of downwind and that the "area of greatest threat" should be avoided by at least 20NM. Although the flight path that the flight crew decided on would only be at best 10NM clear of the weather cells on either side and downwind of one of the weather cells, it should be noted that these FCTM recommendations are not mandatory but serve as a framework for pilots to use in their decision making. Thus, it is understandable that the PIC exercised discretion, which is allowed by the FCTM, to achieve a flight path which he assessed to be sufficiently safe and efficient.

2.3 The recommendation to maintain at least a 20NM laterally clear of the edge of the "area of greatest threat" is due to the threat of turbulence and wind shear that may extend beyond the edge of the weather cells or visible thunderstorms. When a pilot decides to exercise his discretion to fly the aircraft with less clearance than that recommended in the FCTM, the probability of a turbulence encounter is increased. Specific to this occurrence, the PIC could have considered additional mitigating measures, such as instructing the cabin crew to be seated, which may have reduced the risk of injury. The flight crew appeared to have decided on navigating through the clear path between the two weather cells by 0913hr as they requested to ATC for a heading change. An instruction to the cabin crew to be seated at this point would have been approximately five minutes before the aircraft arrived in the vicinity of the clear path between the two clouds and reduced the risk of turbulence injury.

2.4 Prior to the aircraft entering a layer of cloud, the flight crew was able to use both their vision and WXR to navigate towards the clear path between the two

weather cells. However, once the aircraft entered the layer cloud the flight crew could only rely on the WXR for navigation. The WXR limitations mentioned in paragraph 1.8.1.5, might have been what the flight crew experienced which did not allow them to accurately navigate between the two weather cells.

2.5 By the time the aircraft exited the layer of cloud and the flight crew could see the external environment, they realised that they were much closer to the left weather cell than expected. The PIC had to initiate a heading change but the aircraft still could not avoid a turbulence encounter.

2.6 This occurrence serves as a reminder for the following:

(a) The aircraft onboard WXR has limitations. Pilots should be mindful that the displayed weather information may not accurately represent the external weather conditions, especially during poor visibility conditions where the WXR is the primary source of information and where it is not possible to look outside of the cockpit to cross-check the actual weather conditions.

(b) Pilots should maintain a conservative mindset when dealing with weather. In situations where the FCTM's recommended distances from the "area of greatest threat" cannot be maintained, pilots should ensure that all passengers and cabin crew are seated with their seatbelt fastened when necessary.

3 CONCLUSIONS

From the information gathered, the following findings are made. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

3.1 The aircraft commenced descent after receiving an instruction from Shanghai radar control at about 0911hrs. The PIC decided to leave the fasten-seat-belt signs on and made a PA announcement for the passengers to be seated and fasten their seat belts while allowing the cabin crew to continue with their duties.

3.2 Shortly after commencing descent, the flight crew observed that the WXR display showed widespread weather including two weather cells on their flight path with a clear area between the two weather cells which they could also sight out of the windshield. They assessed both weather cells to be “areas of greatest threat”.

3.3 The PIC decided to navigate the aircraft through the 20NM wide clear path between the two weather cells.

3.4 The aircraft entered a layer of cloud and had to rely on the WXR for navigation.

3.5 When the aircraft exited the layer of cloud, the flight crew realised that the aircraft was very close to the left weather cell requiring the flight crew to initiate a heading change.

3.6 The aircraft encountered turbulence as it descended through 27,500 feet.

4 SAFETY ACTIONS

Arising from discussions with the investigation team, the organisation(s) has/have taken the following safety action.

4.1 The operator revised and reissued the SCP on 24 July 2025 to encourage its pilots to adopt a more conservative approach and, when needed, apply SCP even if they are operating a non-SCP sector through the inclusion of the following text:

Crew should assess the weather during the climb and descent phases and proactively adopt a conservative turbulence management approach by utilizing SCP whenever necessary.

4.2 The operator has developed the scenario of unanticipated turbulence and incorporated it into its joint technical and cabin crew training. All crew members have competed this training at least once as of 5 May 2026. This scenario also forms part of the operator's crew resource management recurrent training.

4.3 The operator introduced a new Rapidly Developing Cumulus Area[12] (RDCA) tool on 16 July 2025 as an additional layer of information in the weather awareness solution application installed in the electronic tables provided to its flight crew. The tool provides the pilots with information to enhance turbulence monitoring and make more accurate assessments for flight management.

[12] RDCA is a nowcast product developed by Japan Meteorological Agency to help forecast area of cumulus clouds that is growing vigorously and has the potential to quickly develop into thunderstorms or cumulonimbus clouds

5 SAFETY RECOMMENDATIONS

In view of the safety actions taken by the operator, no safety recommendation is proposed for the operator.