

Status Report

AX001-1/-2/02
August 2002

Factual Information

Type of Occurrence: accident
Date: 01. July 2002
Location: near Überlingen /Lake Constance
Aircraft: Transport category aeroplanes
Manufacturer / Model: 1. Tupolev / TU154 M
2. Boeing / B757-200
Injuries to Persons: 71 persons fatally injured
Damage: both aircraft destroyed
Other Damage: damage to fields and forest

Tupolev TU154 M

At 18:48 hrs the aeroplane took off from Moscow/ Domodedovo airport for a charter flight to Barcelona. 12 crew members and 57 passengers, of whom 45 were children and adolescents and 12 were adults, were aboard the aeroplane.

At 21:15 hrs the aeroplane entered the German airspace and was guided by Munich Radar. The clearance given already previously included a direct approach to the Trasadingen VOR at a cruise flight level of FL 360 (36 000 feet). With the change to the Swiss air traffic control (ACC Zurich) at 21:30 hrs the aeroplane was guided on the frequency of 128.050 MHz with the transponder code A 7520.

History of the flight

On 1. July 2002 at 21:35:32 hrs¹ a Tupolev TU 154 M on its flight from Moscow /Russia to Barcelona/ Spain and a Boeing B757, which was on a flight from Bergamo/Italy to Brussels/Belgium, collided near the town of Überlingen (Lake Constance).

Following the collision both aeroplanes crashed on the ground north of the town of Überlingen. The wreckages were spread over seven sites where major and many sites where minor wreckage parts were found.

At 21:34:42 hrs the airborne **T**raffic alert and **C**ollision **A**voidance **S**ystem (TCAS) warned the crew against probable conflicting traffic. Seven seconds later ACC Zurich instructed the crew of the Tupolev to conduct an "expedite descent" to FL 350 and during this advised them of the conflicting traffic. The crew did not confirm this instruction but initiated a descent. Simultaneously the airborne TCAS issued the command to climb. Another seven seconds later the radar controller repeated his instruction to the crew to conduct an expedite descent to FL 350. This instruction was immediately acknowledged by the crew. After that, the radar controller informed the crew about other traffic at FL 360 in the 2 o'clock position.

¹ *all times indicated in UTC

Boeing B757-200

At 13:30 hrs the aeroplane departed from Bahrain airport for a cargo flight to Brussels with one intermediate stop at Bergamo/Italy. Two pilots were aboard the aircraft. The intermediate landing at Bergamo was conducted at 19:10 hrs after a flight time of 05:40 hours, the departure to continue the flight to Brussels was at 21:06 hrs.

With the change to the ACC Zurich at 21:20 hrs the aeroplane was guided on the frequency 128.050 MHz with the transponder code A 7524. A clearance for a direct approach to the Tango VOR as well as for a climb from FL 260 to FL 320 was granted. The crew asked for a clearance to climb to FL 360, which was given app. 4 minutes later (at 21:26:36 hrs). At 21:29:50 hrs the aeroplane reached this flight level.

At 21:34:42 hrs the airborne TCAS warned the crew against probable conflicting traffic. 14 seconds later (21:34:56 hrs) the crew received the TCAS command to descend. They immediately followed this command and after a further 14 seconds received the command to increase the descent ("increase descent"). At 21:35:19 hrs the crew reported to ATC the avoidance command ("TCAS descent").

Investigation

The investigation was initiated by the BFU immediately after receipt of the notification.

On 02.07.2002, six BFU staff members arrived at the accident site; two other staff members went to Zurich by plane, in order to start with the necessary investigations with ATC Zurich in cooperation with the Swiss Aircraft Accident Investigation Bureau.

In the evening of the same day the flight data recorders of both aeroplanes were recovered and brought to Braunschweig for the purpose of readout and analysis.

The fifth day after the accident the wreckage of both aeroplanes were transported from the various accident sites to a hangar at Friedrichshafen airport.

In accordance with ICAO Annex 13 and with German law, the BFU is competent and responsible for the investigation. The investigation is conducted in accordance with international regulations. The States of Bahrain, Russia, Switzerland and the USA participate in the investigation with accredited representatives and a staff of advisers each and give technical assistance in the search for the cause(s) of the accident.

Up to now, the investigation has led to the following results:

Aircraft/Crews:

- The aircraft collided at a right angle. Whereas the Boeing B757 was on a northern heading (004°) the Tupolev TU154 M had a western heading (274°). The collision occurred at an altitude of app. FL 350 (see attachment 1).
- Both aircraft were equipped with identical collision warning devices (TCAS Honeywell 2000, Change 7). According to the knowledge gathered so far, no malfunction was found.
- Both operators had provided training programmes for TCAS and the crews had completed the corresponding training.
- Neither the history of the flight nor the evaluation of the flight data recorders indicated any technical defects on the aeroplanes.

Air Traffic Control:

- In the ACC Zurich maintenance work on the system was performed in the late evening of the accident day, during this period of time the system was operated in the "fallback mode". The horizontal separation minima had been increased from 5 to 7 nm. According to this, the horizontal distance between aeroplanes flying at the same altitude must be at least 7 nm, which corresponds to a flight time of app. one minute. During this period of time the ground based collision warning system STCA (**Short Term Conflict Alert**) was not available. The direct phone connections to the adjacent air traffic control services were not available either.
- At the moment of the collision one controller was on the sector controller workplace. He had to monitor two workplaces with radar screens. A second controller on the night shift was outside the office for a break. In addition there was one assistant on the sector workplace. She had no traffic control tasks but was responsible only for the receipt, the processing and the transmission of reports and flight plans. This crew composition was corresponding to the normal night shift at the ACC Zurich.
- App. two minutes prior to the collision the STCA system of the UACC (**Upper Area Control Center**) at Karlsruhe issued a warning to advise of a probable collision. The radar controller of the UACC tried several times to contact the ACC Zurich via the direct telephone line. It was not possible to establish a connection.

Reconstruction of the collision:

The aircraft wreckage parts recovered were layed out in a hangar at Friedrichshafen airport and inspected for traces of the collision. During this inspection, traces in the form of scratch marks, paint scrape-offs and red paint traces were found on the left side of the TU154 M fuselage in the area of the two overwing emergency exits.

On the lower surface of the right wing of the TU154 M there were scratch marks over a length of app. 3.60 m and a width of app. 0.90 m running into the direction of the main landing gear fairing. The scratch marks were running at an angle of app. 45° into the direction of the longitudinal axis of the TU154 M. The fairing of the right main landing gear had been torn off over a length of app. 2.80 m. Besides red paint traces remainings of the honeycomb structure of the B757 rudder were found on this wreckage part.

The two aircraft collided first with the vertical tail surface of the of B757 and the left side of the TU154 M fuselage in the area of the two above mentioned emergency exits (see attachment 3).

Distribution of wreckage parts:

The TU154 M had broken in flight into four main portions (fuselage, right wing, left wing and tail unit including power plants). These parts had crashed on the ground southwest of the village of Owingen (see attachment 2).

The aircraft fuselage was found in the area of the village of Brachenreuthe in flat terrain. 300 m meters north of this site, the tail unit and the power plants had impacted the ground. The left wing had fallen into the garden of a residential building app. 2 km northeast of the fuselage. The right wing of the aeroplane was found app. 800 m south of the fuselage. All parts except the fuselage showed traces of a fire.

The B757 had crashed on the ground app. 8 km north of the TU154 M in the area of Taisersdorf. Shortly before the impact both power plants had separated from the aircraft. They were found at a distance of app. 500 m from the main wreckage (see attachment 2). Upon the impact, a fire broke out.

Other findings:

From the recordings of the flight recorders it is to be recognized that crew members of both aeroplanes have realized the other aeroplane several seconds prior to the collision and that they have tried to prevent the collision by corresponding flight manoeuvres.

In the further course of the investigation, the findings made will be refined and expanded. For this purpose the processes at the various "workplaces" of the persons involved, including their general conditions of work, will be brought into a relationship to the "Chain of Events" of the accident and analysed.

Attachments:

1. Flight tracks and collision
2. Collision and distribution of the wreckage
3. Collision
4. Chain of Events

Investigator-in-charge Schöneberg

editor:

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Flugunfalluntersuchung
(Federal Bureau of Aircraft
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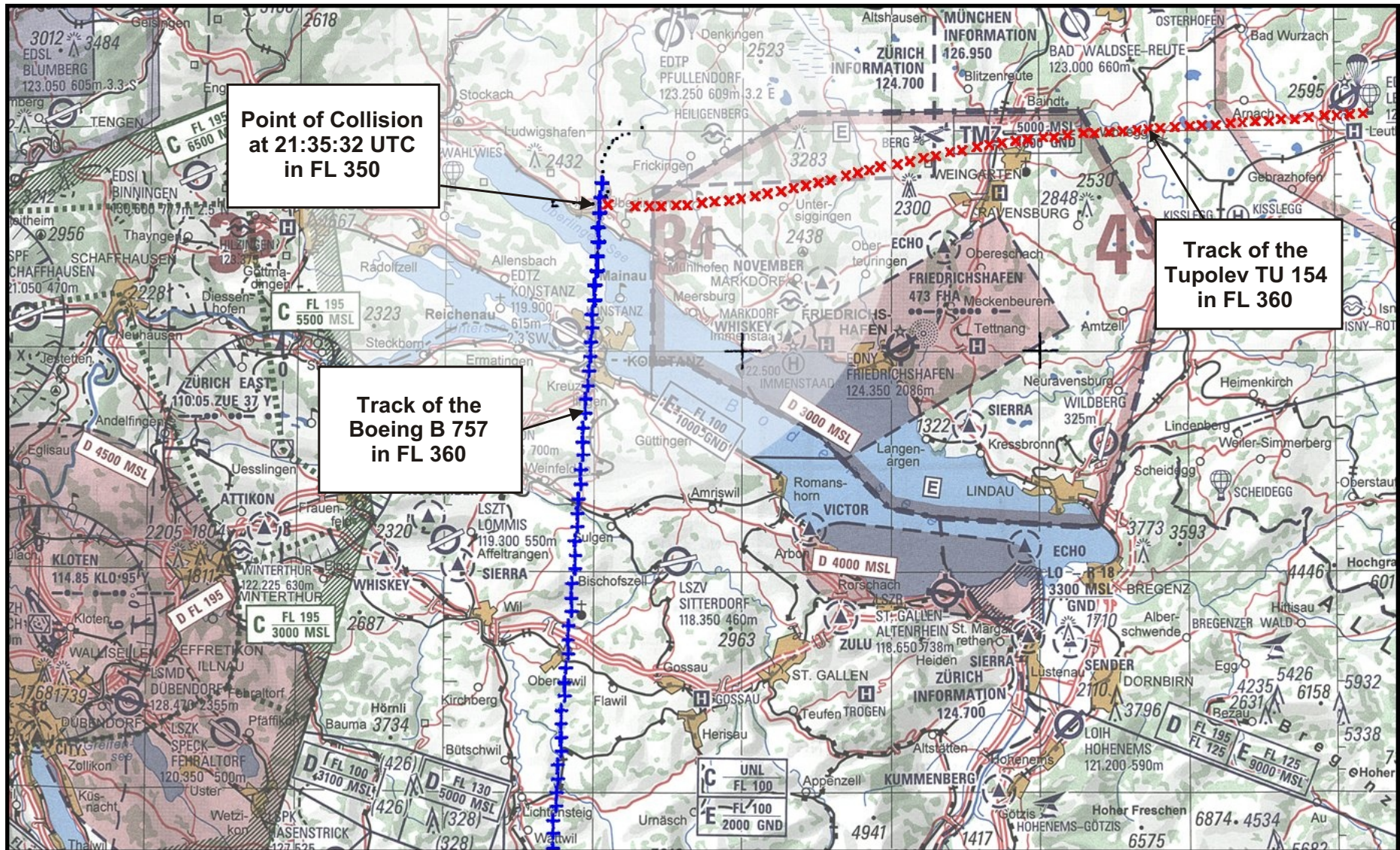
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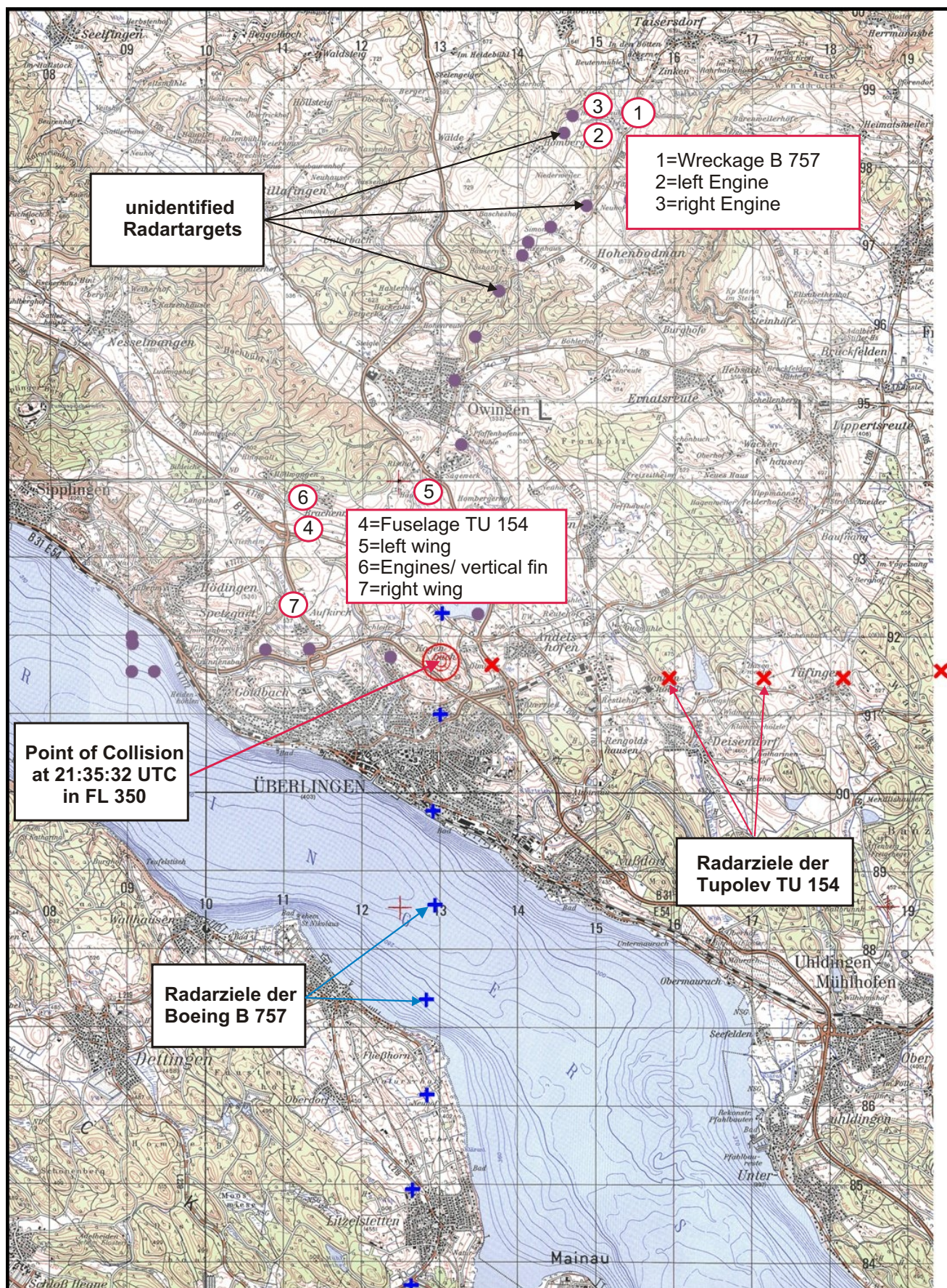
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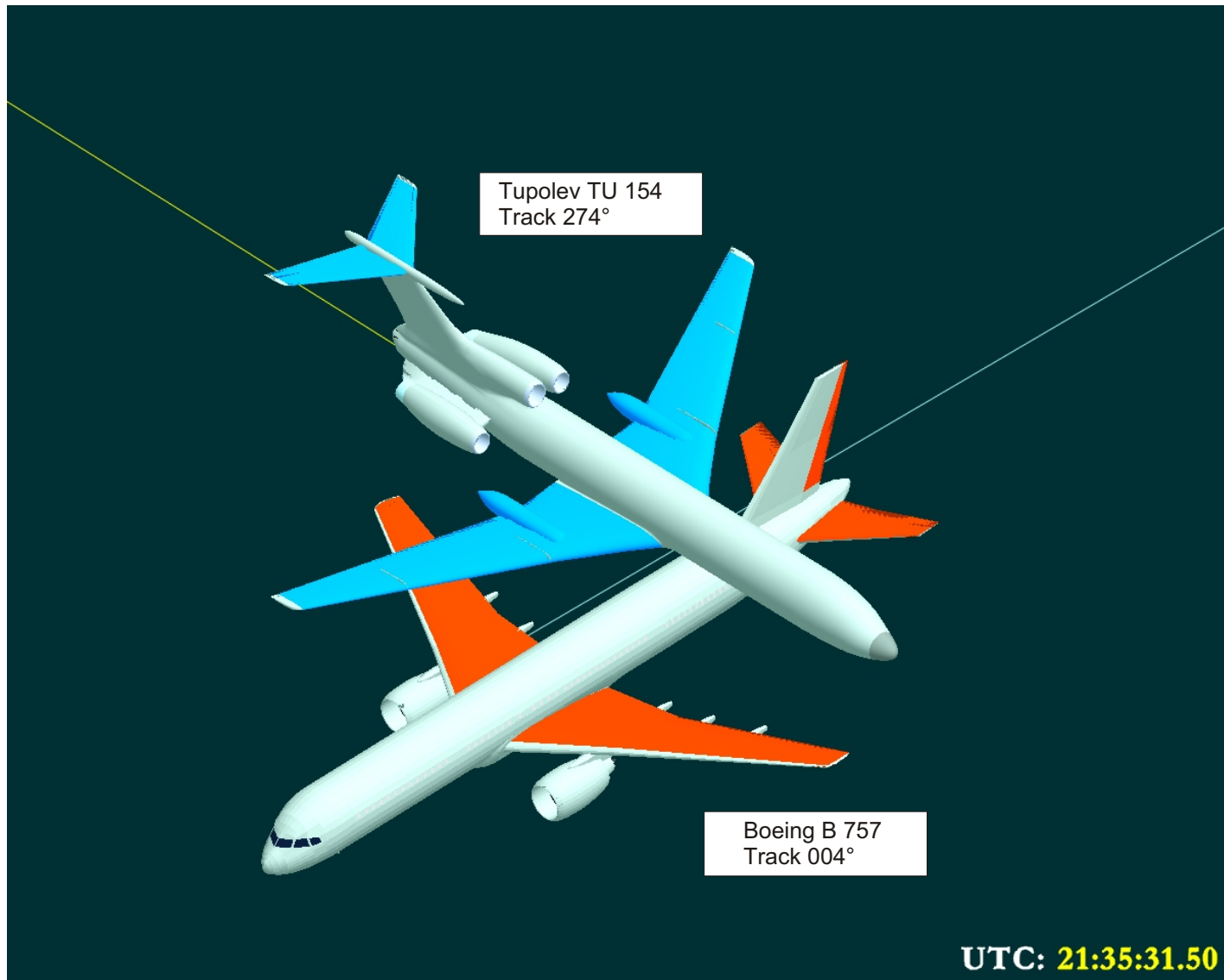
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Flightracks and Collision of Tupolev TU 154 M with Boeing B 757-200

Collision and wreckage distribution





Collision Tupolev TU 154 M with Boeing B 757-200

Chain of Events

Time	Boeing B 757-200; Flight DHX 611	Tupolev TU 154 M; Flight BTC 2937
21:21:50 UTC	Initial call to ACC Zurich on 128.050 MHz at FL 260.	
21:22:54 UTC	The crew is instructed to climb to FL 320 and cleared direct to Tango VOR.	
21:22:59 UTC	The crew requests a climb to FL 360. ACC Zurich announce that the clearance for this climb will be granted 4 to 5 minutes later.	
21:26:36 UTC	The crew receives the instruction to climb to FL 360.	
21:29:50 UTC	The a/c reaches FL 360.	
21:30:11 UTC		Initial call to ACC Zurich on 128.050 MHz at flight level FL 360.
21:34:42 UTC	The airborne TCAS alerts the crew of probable conflicting traffic ("Traffic, Traffic").	The airborne TCAS alerts the crew of probable conflicting traffic ("Traffic, Traffic").
21:34:49 UTC		The radar controller instructs the crew to an expedite descent to FL 350. This instruction was given together with an information about conflicting traffic.
21:34:56 UTC	The TCAS issues an avoidance command to descend. The crew follows this command without hesitation.	The crew initiates a descent. The TCAS issues an avoidance command to climb.
21:35:03 UTC		The radar controller of ACC Zurich repeats the instruction to an expedite descent to FL 350. The crew immediately confirms. After that the radar controller advises the crew of other traffic at FL 360 in the "2 o'clock position".
21:35:10 UTC	The crew receives the TCAS command to increase the descent ("increase descent").	
21:35:19 UTC	The crew reports to ACC Zurich that following a TCAS command they have initiated a descent ("TCAS descent").	
21:35:24 UTC		The crew receives the TCAS command to increase the climb ("increase climb").
21:35:32 UTC	Collision with the Tupolev TU 154 M at app. FL 350.	Collision with the Boeing B 757 at app. FL 350.