ACAS II Bulletin – Near collision over Yaizu

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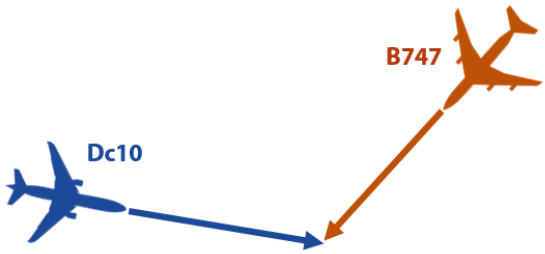
Twenty-one years ago, on 31 January 2001, near the city of Yaizu in Japan a midair collision between a Boeing 747-400 and a McDonnell Douglas DC-10-40 was narrowly avoided. Although over two decades have passed since this event, the lessons learned from this accident remain valid. The most important one – **follow the RA.**

Let's quickly recap what happened over Yaizu. As typically happens, there were several contributing factors. Here, we will not discuss how ATC actions led to the development of the conflict and how the controllers were trying to resolve the conflict once the RAs have been issued; we will rather focus on pilot actions and their responses to TCAS RAs. More information about the accident can be found on SKYbrary.

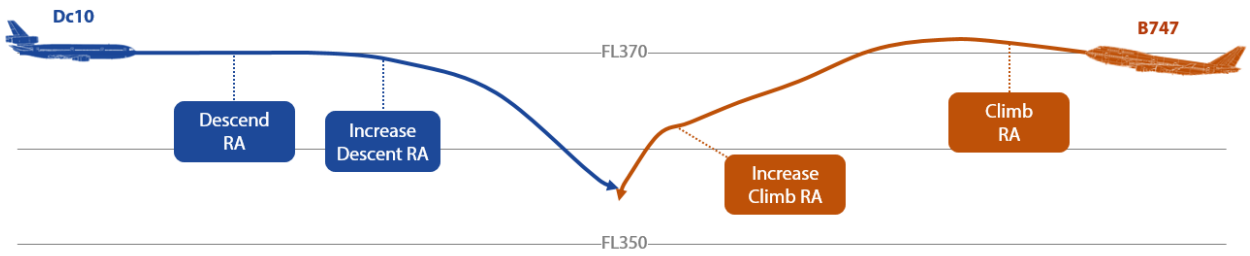
The DC-10 was cruising at FL370 while the B747 was climbing initially to FL350. The air traffic controller, not realising that the aircraft paths will cross, cleared the B747 to FL390. The controller realised that the aircraft were on a collision course when the B747 was passing through FL369 and the aircraft were some 10 miles apart on almost perpendicular tracks. To resolve the conflict, the B747 was instructed to descend back to FL350.

Simultaneously with the controller instruction, coordinated TCAS RAs were issued to both aircraft: the DC-10 received a Descend RA while the B747 a Climb RA. Both RAs required the vertical rate of 1500 ft/min. (in the opposite vertical sense).



The B747 pilot acknowledged the ATC descent instruction, stopped the climb at FL372 and started to descend. After the event (during the investigation), it was noticed that during the readback, the TCAS RA aural annunciation "Climb" could be heard in the background. The B747 pilot could see the DC-10 contrail and determined that following the ATC descent instruction, rather than the Climb RA, would resolve the conflict. He believed the controller had issued the instruction to descend taking into account the whole traffic situation including the DC-10.

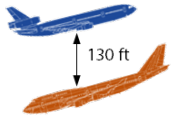
In the meantime, on the receipt of the Descend RA the DC-10 pilot disengaged the autopilot, set power to idle and started a descent. Fifteen seconds after the initial RA, the RA on the DC-10 strengthened to Increase Descent (requiring the descent rate of 2500 ft/min.) and the crew deployed speed brakes in order to achieve a higher descent rate and turned the fasten seat belts signs on.



The B747 RA strengthened to Increase Climb 31 seconds after the initial RA. Although the strengthening RA required the climb with the rate of 2500 ft/min., the B747 crew continued their descent. The visibility was excellent and each crew had the other aircraft in sight. Both aircraft continued to descend towards each other at similar vertical rates.

At the last moment, the DC-10 pilot pulled up and the B747 crew increased their rate of descent to avoid an imminent collision. The B747 passed below the DC-10 at FL357, some 36 seconds after the initial RAs.

At the closest point of approach, the estimated **vertical separation was 130 feet.** To put this number into perspective: that's about twice the height of the B747.



The late avoiding manoeuvres by both crews prevented the collision; however, the sudden change in the g-forces caused 100 injuries on board the B747, nine of them serious, as well as damage to the cabin interior, including a drinks cart being catapulted and embedded above the passenger cabin ceiling. Because of the injuries and damage to the aircraft, this event has been classified as an accident.

The B747 diverted, so the injured could receive medical attention while the DC-10 continued to its destination.

A correct response to the RAs by the B747 crew would have prevented this incident altogether. The investigation has established that had the B747 followed its initial Climb RA, it would have reached FL378 at the time of the closest approach.

The investigators observed that it is practically impossible to make correct visually assessment of the motion of another aircraft at high speed and high altitude. That becomes only possible when the two aircraft are very close.

It is worth noting that both aircraft were equipped with TCAS II version 6.04a which was the predominant TCAS version at the time. Version 6.04a was unable to reverse RAs in geometries like this one. Today, in Europe and elsewhere, version 7.1 is mandated which allows for RA reversals in similar cases.

The investigation concluded that the ICAO provisions in force at the time were not sufficiently clear. In the wake of this accident as well as the 2002 Überlingen midair collision, the relevant provisions were amended to clearly state pilot actions in case of RA: **"follow the RA even if there is a conflict between the RA and an air traffic control (ATC) instruction to manoeuvre".**

Over Yaizu, a midair collision between two wide body aircraft, carrying 677 people, was able to be avoided purely by chance. Let this event serve as a reminder that **TCAS Resolution Advisories must be followed correctly and in a timely manner.**

Pilot statements to the investigators:

- *"I could visually see the top of the B747 fuselage and I judged that it was increasing its descent rate. I felt that the situation was extremely dangerous. I think the pilot flying [first officer] felt the same, but we had no time to communicate, and we both pulled back on the yokes almost simultaneously. A big aircraft passed below our aircraft in an instant".*
  DC-10 captain
- *"I saw the other aircraft become larger and larger and lower its nose when it was just off the tip of our wing. The other aircraft was so close that I thought its tail would snag our aircraft".*
  DC-10 first officer
- *"The Dc10 appeared to fill the windshield."*
  B747 captain

Learning points:

- Pilots must always follow the RA promptly and accurately unless doing so would clearly jeopardise the safety of the aircraft.
- Pilots must not manoeuvre contrary to the RA.
- RAs take precedence over ATC clearances. Pilot must never manoeuvre in the opposite sense to an RA even when there is an ATC avoiding instruction contrary to the RA.
- Pilots must follow an RA, even if they believe they have the conflicting traffic in sight.

Further reading:

- SKYbrary article about the accident and ensuing legal actions
- Full accident report (Japanese Aircraft and Railway Accident Investigation Commission)

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