



McGill



TURKISH AVIATION ACADEMY

İTÜ



# \* Aviation Safety Regulation

Paul Stephen Dempsey

McGill University Institute of Air & Space Law

Some slides from Singapore CAA, France BEA, US FAA, ICAO and various websites.

- \*The Chicago Convention of 1944 created the International Civil Aviation Organization [ICAO] and gave it quasi-legislative authority to promulgate standards and recommended practices [SARPs] as Annexes to the Chicago Convention. These standards are binding upon member States that fail to notify ICAO of the differences in their domestic law.



## \*The Chicago Convention

- \* Article 12 of the Convention requires every contracting State to keep its regulations uniform, to the greatest extent possible, with those established under the Convention.
- \* Article 37 attempts to achieve uniformity in air navigation, by requiring that every contracting State cooperate in achieving the “highest practicable degree of uniformity in regulations, standards, procedures, and organization in relation to aircraft personnel, airways and auxiliary services in all matters in which uniformity will facilitate and improve air navigation.”
- \* The sentence that follows provides, “[T]o this end [ICAO] shall adopt and amend from time to time . . . international standards and recommended practices and procedures” addressing various aspects of air navigation.
- \* Therefore, ICAO’s 191 member States have an affirmative obligation to conform their domestic laws, rules, and regulations to the international leveling standards adopted by ICAO.

## \* Uniformity of Law



- \* Annex 1 (Personnel Licensing), Annex 6 (Operation of Aircraft), and Annex 8 (Airworthiness of Aircraft) require ICAO's member States to promulgate domestic laws and regulations to certify airmen, aircraft, and aircraft operators as airworthy and competent to carry out safe operations in international aviation.
- \* Subject to the notification of differences under Article 38 of the Convention, the legal regime effectively assumes that States are in compliance with these safety mandates.
- \* Under Article 33, States are obliged to recognize the validity of the certificates of airworthiness and personnel licenses issued by the State in which the aircraft is registered, so long as the standards under which such certificates or licenses were rendered are at least as stringent as those established under the Chicago Convention.

## \* Certificates of Airworthiness



# \* AIRCRAFT CERTIFICATION



Design	<ul style="list-style-type: none"><li>• Type Certificate validation or acceptance</li></ul>
Production	<ul style="list-style-type: none"><li>• Approval of Modifications &amp; Repairs of Aircraft Parts</li></ul>
Registration	<ul style="list-style-type: none"><li>• Certificate of Registration</li></ul>
Airworthiness	<ul style="list-style-type: none"><li>• Certificate of Airworthiness</li></ul>
Maintenance	<ul style="list-style-type: none"><li>• Operator's Maintenance Program</li></ul>

# \* AIRCRAFT OPERATOR CERTIFICATION

• Organisation, Staffing & Training	• Flight and cabin crew scheduling
• Facilities & Equipment	• Operational control & flight dispatch
• Flight Safety Documentation	• Standard Operating Procedures
• Operations Manual	• Ground handling arrangements
• Aircraft Operating Information	• Authorization for the transport of dangerous goods by air
• Routes & Aerodromes Manual	• Authorization for aircraft lease, charter and interchange
• Air operator accident prevention and flight safety programme	• Aircraft operation security measures
• Training Programmes	• Safety Management Systems



# MAINTENANCE ORGANIZATION CERTIFICATION



- Facility & Personnel Requirements
- Certifying Staff
- Equipment, Tools & Materials
- Maintenance Data
- Certification of Maintenance
- Maintenance Records
- Reporting of unairworthy conditions
- Safety Management System
- Maintenance Procedures & Quality System

# \* REGULATION OF AVIATION PERSONNEL

## Flight Crew

- Pilot Licence
- Ratings



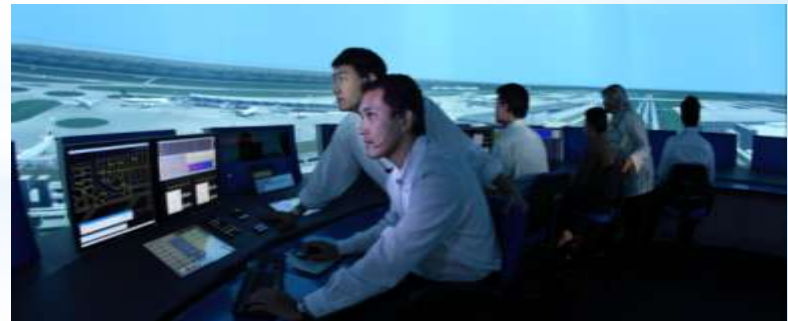
## Aircraft Maintenance Engineers

- Aircraft Maintenance Engineer License
- Ratings



## Air Traffic Controllers

- Air Traffic Controller License
- Ratings

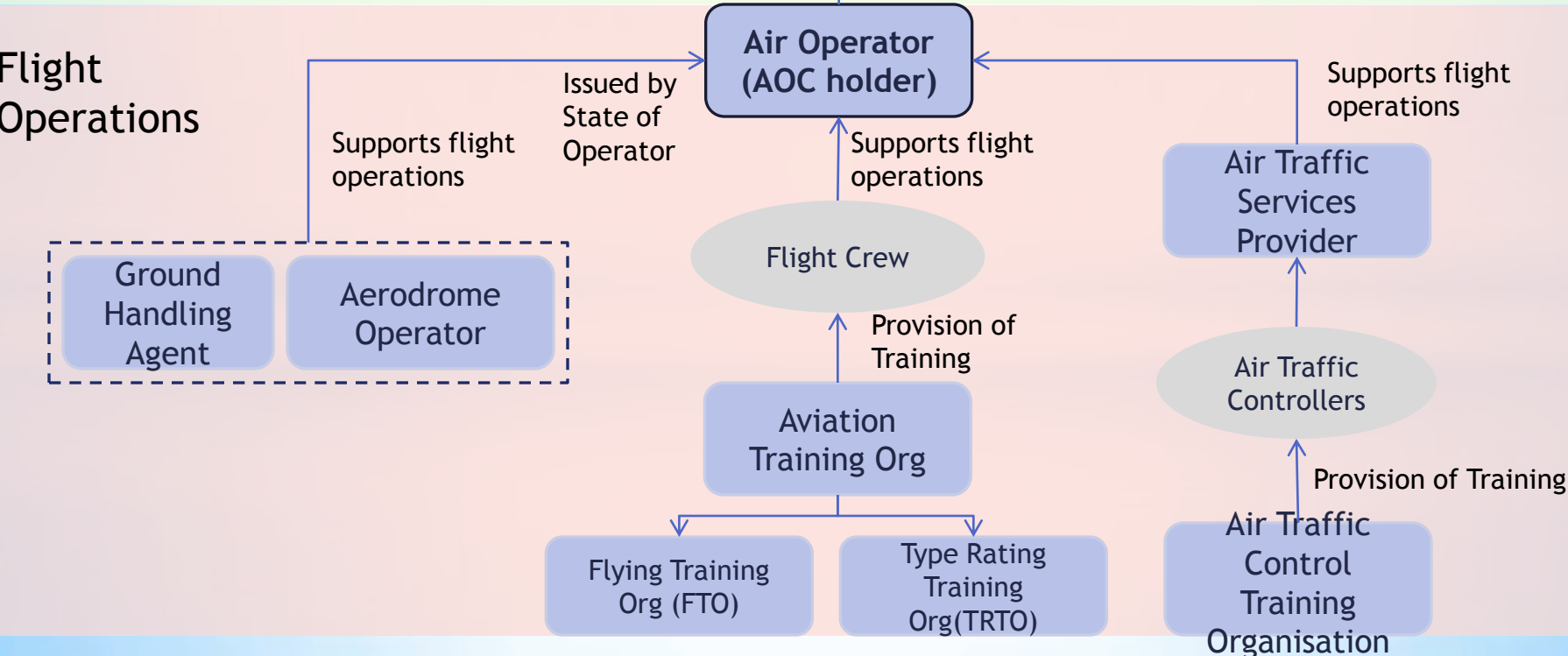
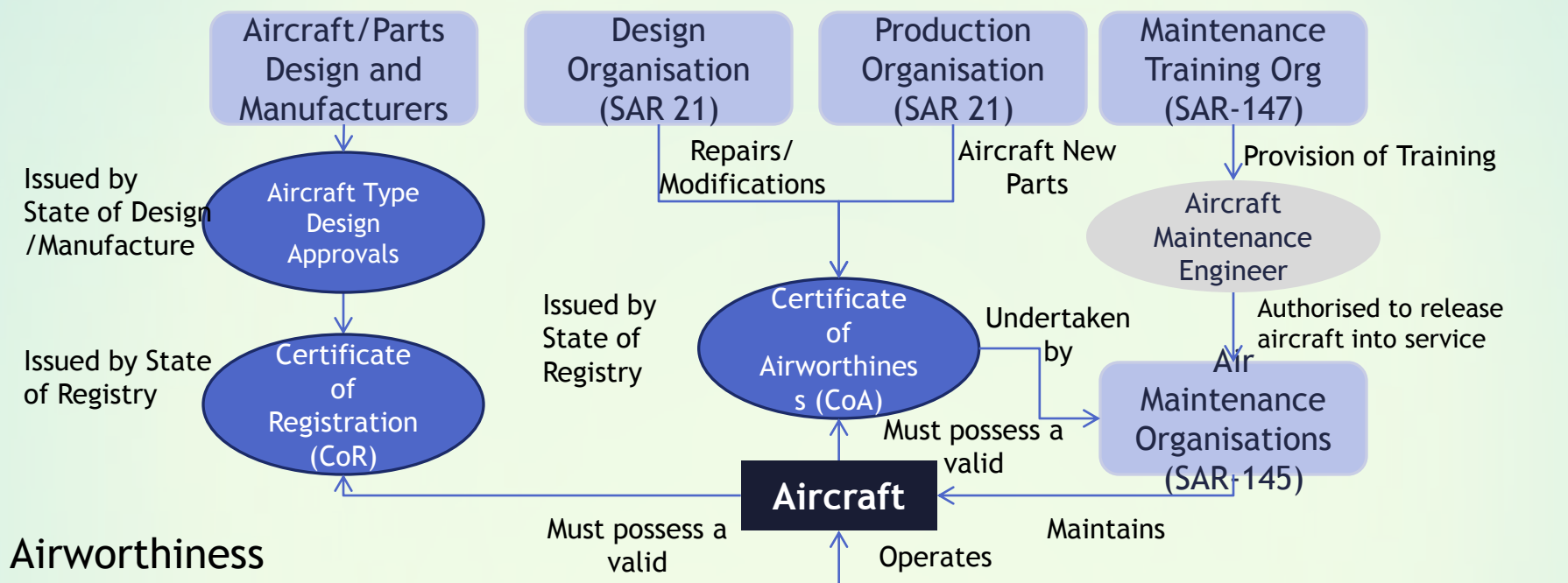




## Aerodrome Certification

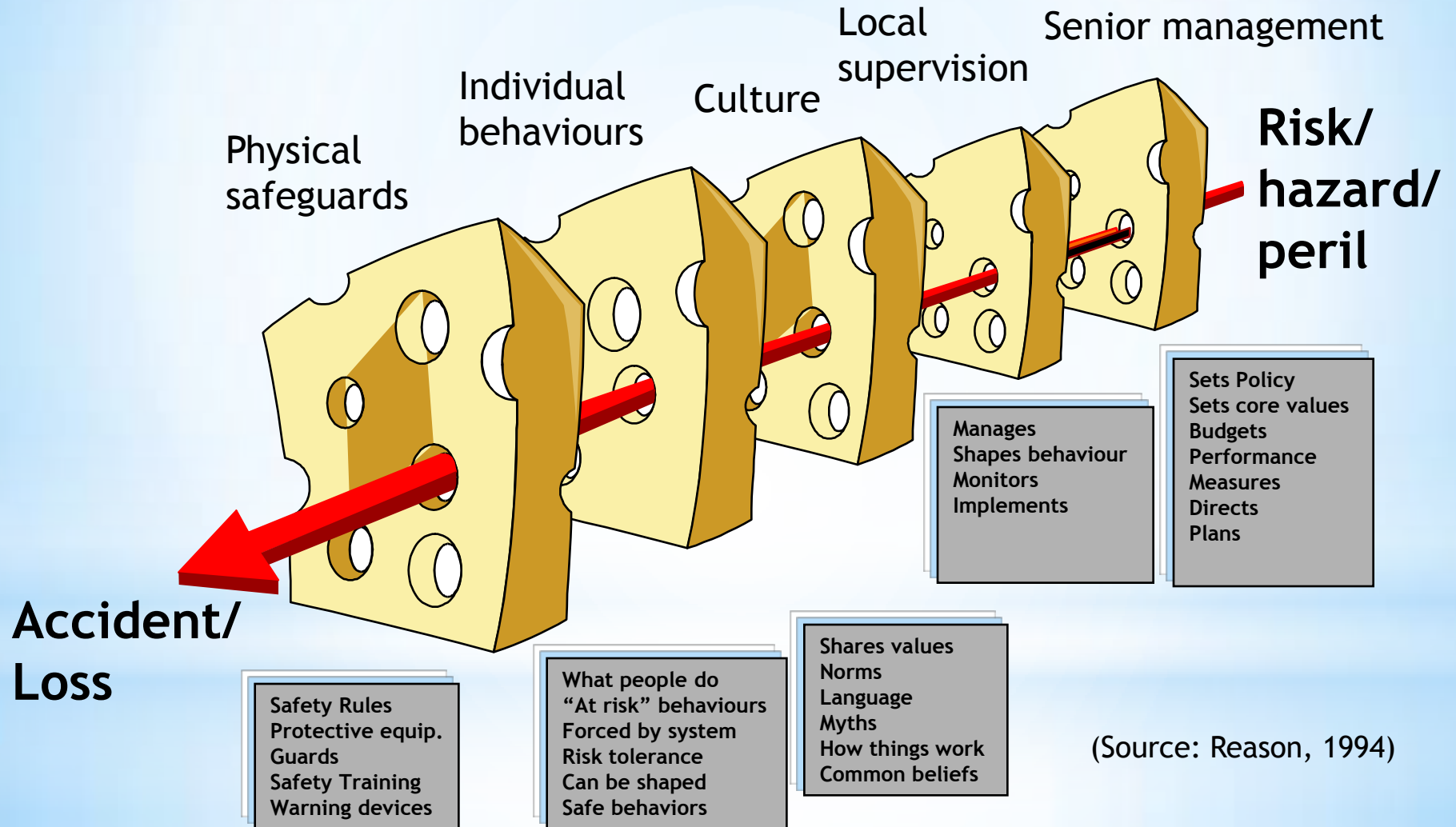
• Organisation, Staffing & Training	• Aerodrome lights, markings, markers & signs
• Technical & administrative guidance & equipment	• Aerodrome maintenance
• Aerodrome manual	• Aerodrome operating procedures
• Provision of aerodrome data & coordination	• Safety management systems
• Aerodrome physical characteristics, facilities and equipment	







# \* ACCIDENT & INCIDENT INVESTIGATION



# \* ACCIDENT & INCIDENT INVESTIGATION

<b><u>Sole Objective</u></b>	<ul style="list-style-type: none"><li>• Accident prevention</li><li>• <u>Not</u> to apportion blame or liability</li></ul>	
<b>Notification</b>	<ul style="list-style-type: none"><li>• Flight Crew</li><li>• Operator</li></ul>	
<b>Investigator in charge</b>	<ul style="list-style-type: none"><li>• State of Occurrence</li></ul>	
<b>Accredited Representatives</b>	<ul style="list-style-type: none"><li>• State of Registry</li><li>• State of the Operator</li><li>• State of Design</li></ul>	<ul style="list-style-type: none"><li>• State of the Manufacturer</li><li>• State providing information, facilities or experts</li></ul>
<b>Investigation Phases</b>	<ul style="list-style-type: none"><li>• On notification</li><li>• Field Phase</li></ul>	<ul style="list-style-type: none"><li>• Analysis Phase</li><li>• Report Writing Phase</li></ul>
<b>Report</b>	<ul style="list-style-type: none"><li>• Draft Final Report</li><li>• Final Report</li><li>• Safety Recommendations</li></ul>	

# \*Objective of the Investigation

*The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents.*

*It is not the purpose of this activity to apportion blame or liabilities.*



*Annex 13*

# \* Annex 13 - Independence of the Accident Investigator

- \* Annex 13 recommends that any court or administrative action designed to apportion blame or impose liability should be independent from the accident or incident investigation:
- \* “[t]he accident investigation authority shall have independence in the conduct of the investigation and have unrestricted authority over its conduct . . .”.
- \* The State shall establish “an independent accident and incident investigation process, the *sole* objective of which is the prevention of accidents and incidents, and not the apportioning of blame or liability. . . . In the operation of the SSP (State Safety Programme), the State maintains the independence of the accident and incident investigation organization from other State aviation organizations.”
- \* The investigation consists of the gathering, recording and analysis of all available relevant information, the drawing of conclusions, including the determination of causes and/or contributing factors and, when appropriate, the making of safety recommendations.





# \* Annex 13 - Accident Investigations

- \* The State conducting the investigation should recognize the need for coordination between the investigator-in-charge (IIC) and judicial authorities.
- \* Most of the evidence gathered should remain confidential unless the judicial authorities determine “that their disclosure outweighs the any adverse domestic and international impact such action may have on that or any future investigations . . .”.
- \* Evidence gathered during the accident or incident investigation, including that given voluntarily, “could be utilized inappropriately for subsequent disciplinary, civil, administrative and criminal proceedings. If such information is distributed, it may, in the future, no longer be openly disclosed to investigators. Lack of access to such information would impede the investigation process and seriously affect flight safety.”
- \* Hence, extreme caution is urged in using evidence gathered for safety investigation purposes in liability or punitive judicial or administrative proceedings, lest the willingness of those involved in an aviation accident be chilled from volunteering useful information.



# \* Annex 13 - Incident Reporting System

- \* Annex 13 requires that States establish both a mandatory and a voluntary incident reporting system.
- \* Such a system must be “non-punitive and afford protection to the sources of the information”, because a “non-punitive environment is fundamental to voluntary reporting”.
- \* In its guidance material, ICAO observes, “Ideally, State-run voluntary incident reporting systems are operated by an organization separate from the aviation administration responsible for the enforcement of aviation regulations.”







## \* DIRECTIVE 94/56/EC

- Obligation to investigate all “civil aviation” accidents and serious incidents
- Sole objective = prevention
- Investigations conducted or supervised by a permanent civil aviation body or entity, functionally independent
- Rights and Powers of investigators
- Accident reports to be made public (12 months)

*\*The body or entity concerned shall be functionally independent in particular of the national aviation authorities responsible for airworthiness, certification, flight operation, maintenance, licensing, air traffic control or airport operation and, in general, of any other party whose interests could conflict with the task entrusted to the investigating body or entity.*



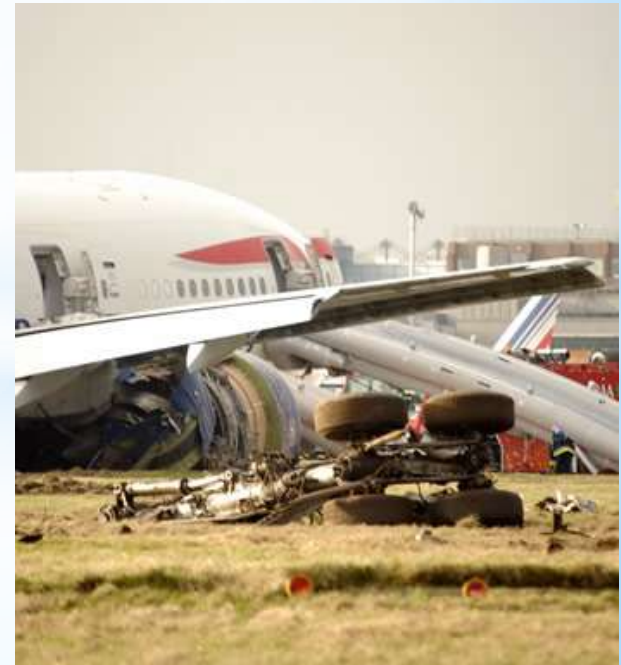
## **\* Directive 94/56/EC**

### **Article 6.1**

## \* Annex 13 - ATTACHMENT E LEGAL GUIDANCE FOR THE PROTECTION OF INFORMATION FROM SAFETY DATA COLLECTION AND PROCESSING SYSTEMS

1.1 The protection of safety information from inappropriate use is essential to ensure its continued availability, since the use of safety information for other than safety related purposes may inhibit the future availability of such information, with an adverse effect on safety. . . .

1.5(c) *inappropriate use* refers to the use of safety information for purposes different from the purposes for which it was collected, namely, use of the information for disciplinary, civil, administrative and criminal proceedings against operational personnel, and/or disclosure of the information to the public . . . .



2.1 The sole purpose of protecting safety information from inappropriate use is to ensure its continued availability so that proper and timely preventive actions can be taken and aviation safety improved.

2.2 It is not the purpose of protecting safety information to interfere with the proper administration of justice in States.

2.3 National laws and regulations protecting safety information should ensure that a balance is struck between the need for the protection of safety information in order to improve aviation safety, and the need for the proper administration of justice.

2.4 National laws and regulations protecting safety information should prevent its inappropriate use.

2.5 Providing protection to qualified safety information under specified conditions is part of a State's safety responsibilities.

# \* Annex 13 - Attachment E

3.1 Safety information should qualify for protection from inappropriate use according to specified conditions that should include, but not necessarily be limited to: the collection of information was for explicit safety purposes and the disclosure of the information would inhibit its continued availability. . . .

3.3 A formal procedure should be established to provide protection to qualified safety information, in accordance with specified conditions.

3.4 Safety information should not be used in a way different from the purposes for which it was collected.

3.5 The use of safety information in disciplinary, civil, administrative and criminal proceedings should be carried out only under suitable safeguards provided by national law.

## \* Annex 13 - Attachment E

# \* Accidents/Incidents – Annex 13, 5.12

## ***Non-disclosure of records***

5.12 The State conducting the investigation of an accident or incident shall not make the following records available for purposes other than accident or incident investigation, unless the appropriate authority for the administration of justice in that State determines that their disclosure outweighs the adverse domestic and international impact such action may have on that or any future investigations:

- a) all statements taken from persons by the investigation authorities in the course of their investigation;
- b) all communications between persons having been involved in the operation of the aircraft;
- c) medical or private information regarding persons involved in the accident or incident;
- d) cockpit voice recordings and transcripts from such recordings;
- e) recordings and transcriptions of recordings from air traffic control units;
- f) cockpit airborne image recordings and any part or transcripts from such recordings; and
- g) opinions expressed in the analysis of information, including flight recorder information.

5.12.1 These records shall be included in the final report or its appendices only when pertinent to the analysis of the accident or incident. Parts of the records not relevant to the analysis shall not be disclosed.



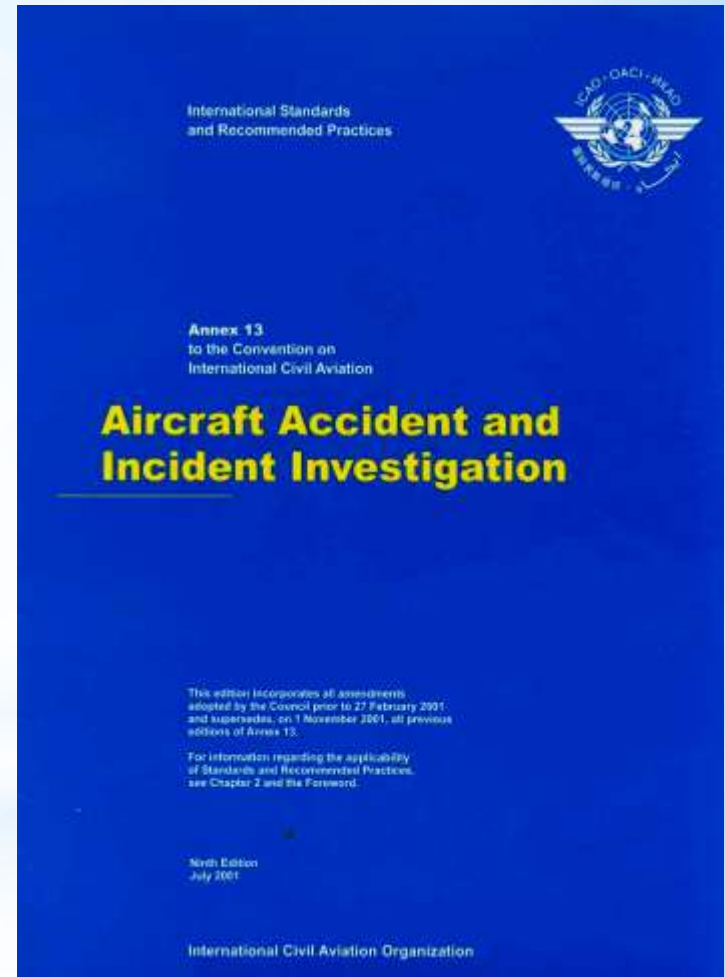
# \* Accidents/Incidents – Annex 13, 5.12

## **Non-disclosure of records**

*Note 1.— Information contained in the records listed above, which includes information given voluntarily by persons interviewed during the investigation of an accident or incident, could be utilized inappropriately for subsequent disciplinary, civil, administrative and criminal proceedings. If such information is distributed, it may, in the future, no longer be openly disclosed to investigators. Lack of access to such information would impede the investigation process and seriously affect flight safety.*

*Note 2.— **Attachment E** contains legal guidance for the protection of information from safety data collection and processing systems.*

5.12.2 The names of the persons involved in the accident or incident shall not be disclosed to the public by the accident investigation authority.



## 4. PRINCIPLES OF EXCEPTION

Exceptions to the protection of safety information should only be granted by national laws and regulations when:

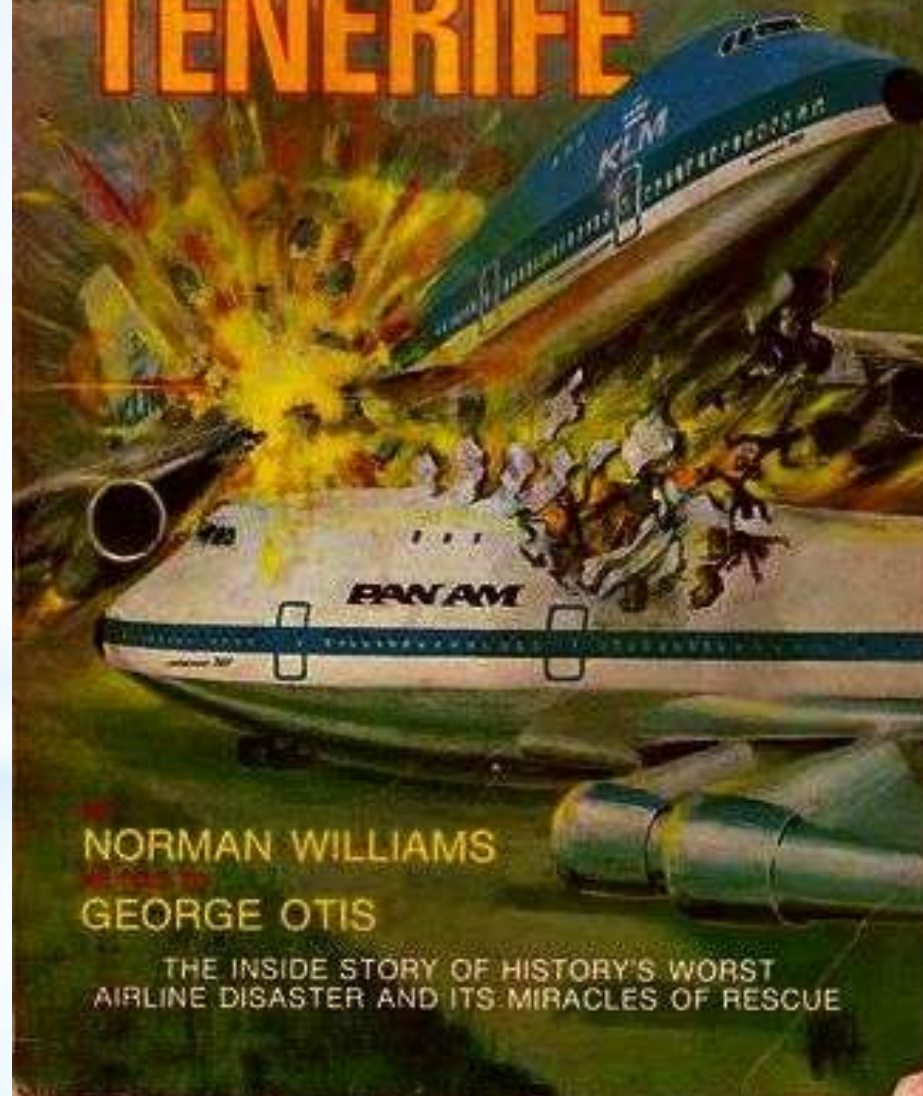
- \* a) there is evidence that the occurrence was caused by an act considered, in accordance with the law, to be conduct with intent to cause damage, or conduct with knowledge that damage would probably result, equivalent to reckless conduct, gross negligence or wilful misconduct;
- \* b) an appropriate authority considers that circumstances reasonably indicate that the occurrence may have been caused by conduct with intent to cause damage, or conduct with knowledge that damage would probably result, equivalent to reckless conduct, gross negligence or wilful misconduct; or
- \* c) a review by an appropriate authority determines that the release of the safety information is necessary for the proper administration of justice, and that its release outweighs the adverse domestic and international impact such release may have on the future availability of safety information.

 **Annex 13 -  
Attachment E**

THE CANARY ISLANDS CRASH

2.95

# TERROR AT TENERIFE



NORMAN WILLIAMS

GEORGE OTIS

THE INSIDE STORY OF HISTORY'S WORST  
AIRLINE DISASTER AND ITS MIRACLES OF RESCUE



# El accidente de Los Rodeos

**2.** El KL 4805 carga combustible para realizar el vuelo de regreso

**Hora del siniestro**  
17:06



**3.** El KL 4805 recibe ordenes de recorrer la pista para girar 180 grados y colocarse en posición de despegue

**4.** Se autoriza al PA 1736 a seguir al KL 4805, abandonando la pista por la tercera salida (C-3)

**1.** El PA 1736, de Pan American, solicita permiso para despegar y le comunican desde la torre de control la situación del KL 4805, de KLM

**5.** El comandante no entiende las ordenes e interpreta que tiene que tomar la calle C-4

**6.** El KL 4805 comienza su despegue sin autorización mientras que el avión de Pan American gira hacia la C-4. Se produce el impacto

En el momento del accidente, la visibilidad era de apenas 500 metros

**TOTAL VÍCTIMAS**  
**583**

**Boeing 747-121** (PA 1736)

**Boeing 747-206B** (KL 4805)

**TRIPULACIÓN:** 16 (9 fallecidos)

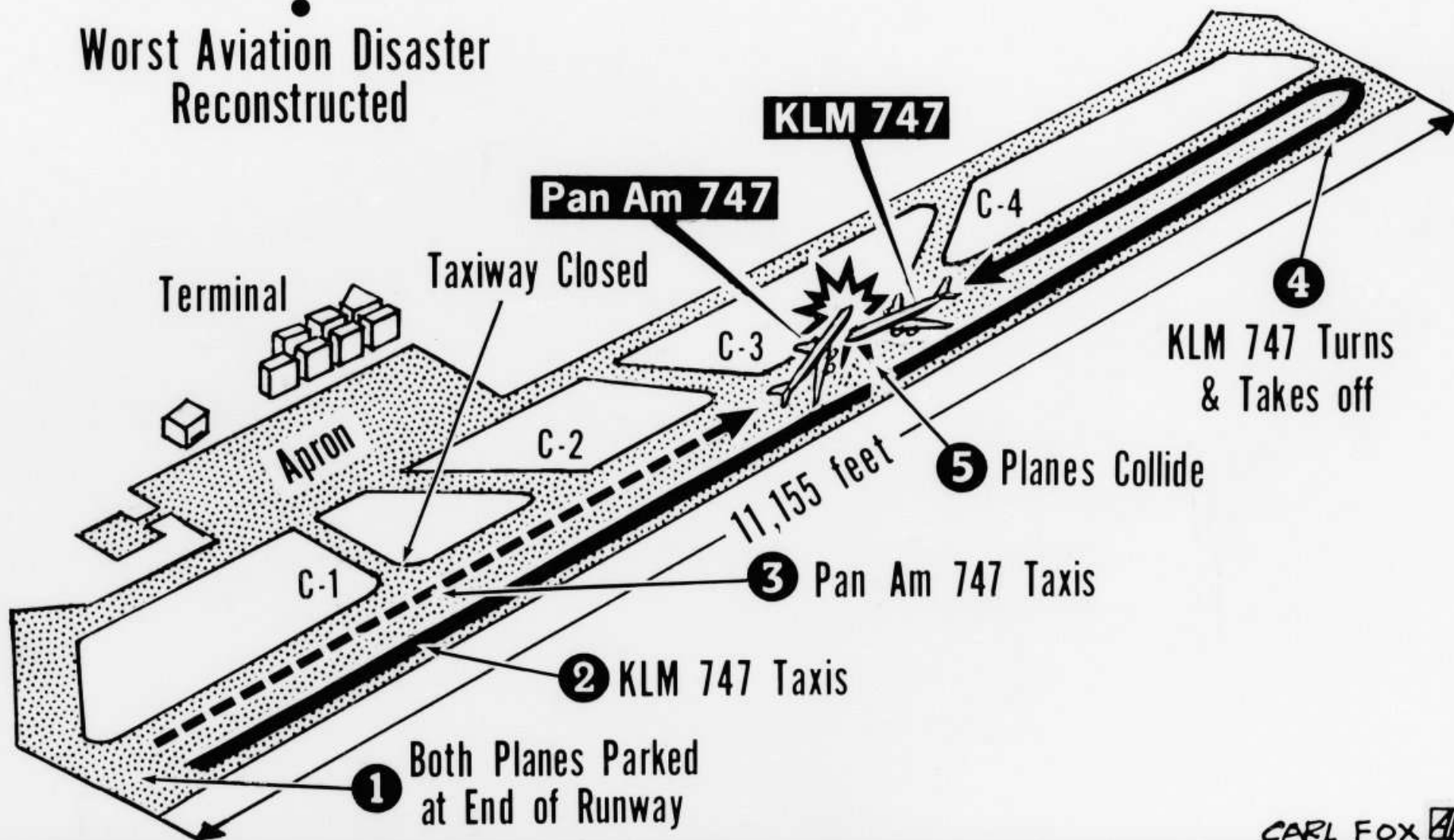
**PASAJEROS:** 380 (326 fallecidos)

**TRIPULACIÓN:** 14 (todos fallecidos)

**PASAJEROS:** 234 (todos fallecidos)

# LOS RODEOS AIRPORT

## Worst Aviation Disaster Reconstructed







Tenerife was the greatest aerial tragedy in terms of loss of life in history - 583 people died. Causes:

- \* Loss of situational awareness by the captain.
- \* Poor communications between ATC and KLM and Pan Am.
- \* Poor decision making by KLM captain, taking off in heavy fog without ATC clearance.
- \* Stress of long waiting at Tenerife, approaching maximum duty time of crew.

# \* Tenerife Accident Report

# Omaha World-Herald



Midlands Edition

*Stricken Jet Misses Sioux City Runway*

## DC-10 Crashes in Flames

By Sharon Rosse

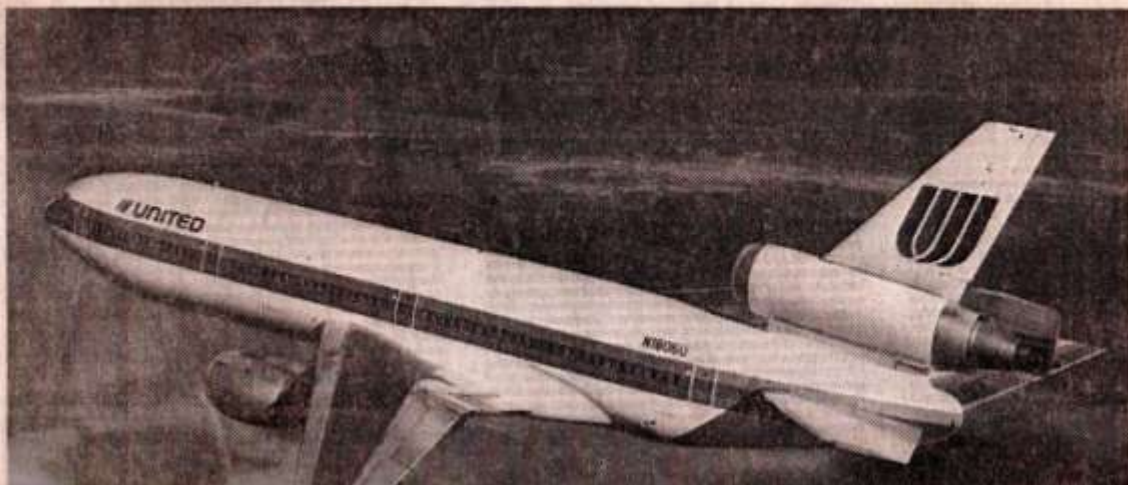
World-Herald Staff Writer

Sioux City, Iowa — As many as 150 people may have survived the crash Wednesday of a United Airlines DC-10 carrying 298 people when it crashed and exploded while trying to make an emergency landing at the Sioux Gateway Airport.

Flight 232 from Denver to Chicago carried 287 passengers and 11 crew members, said Deborah Jones, a United spokeswoman.

Witnesses said some survivors appeared to have been thrown from the plane when it cartwheeled into the ground and burst into flames. Others walked away, witnesses said.

The plane experienced "complete hydraulic failure" before the crash just after 4 p.m. Federal Aviation







The Associated Press

Part of DC-10 fuselage lies in a cornfield near end of the runway ... McDonnell Douglas suspended production of the DC-10 in 1983.

## Just Before Crash, Pilot Says Jet Has 'Complete Hydraulic Failure'

Washington (AP) — The pilot of the DC-10 that cartwheeled on the ground and exploded Wednesday at Sioux City, Iowa, reported "a complete hydraulic failure" just before the crash and had lost an engine earlier, a federal aviation spokesman said.

John Leyden, a spokesman for the Federal Aviation Administration, said hydraulic failure would mean a loss of primary control over nearly every control surface on the wide-bodied, three-engine airliner.

A plane's hydraulic system helps push its wheels down, opens and extends flaps to increase the lift of the wings and governs other control surfaces of the airplane on the wings and

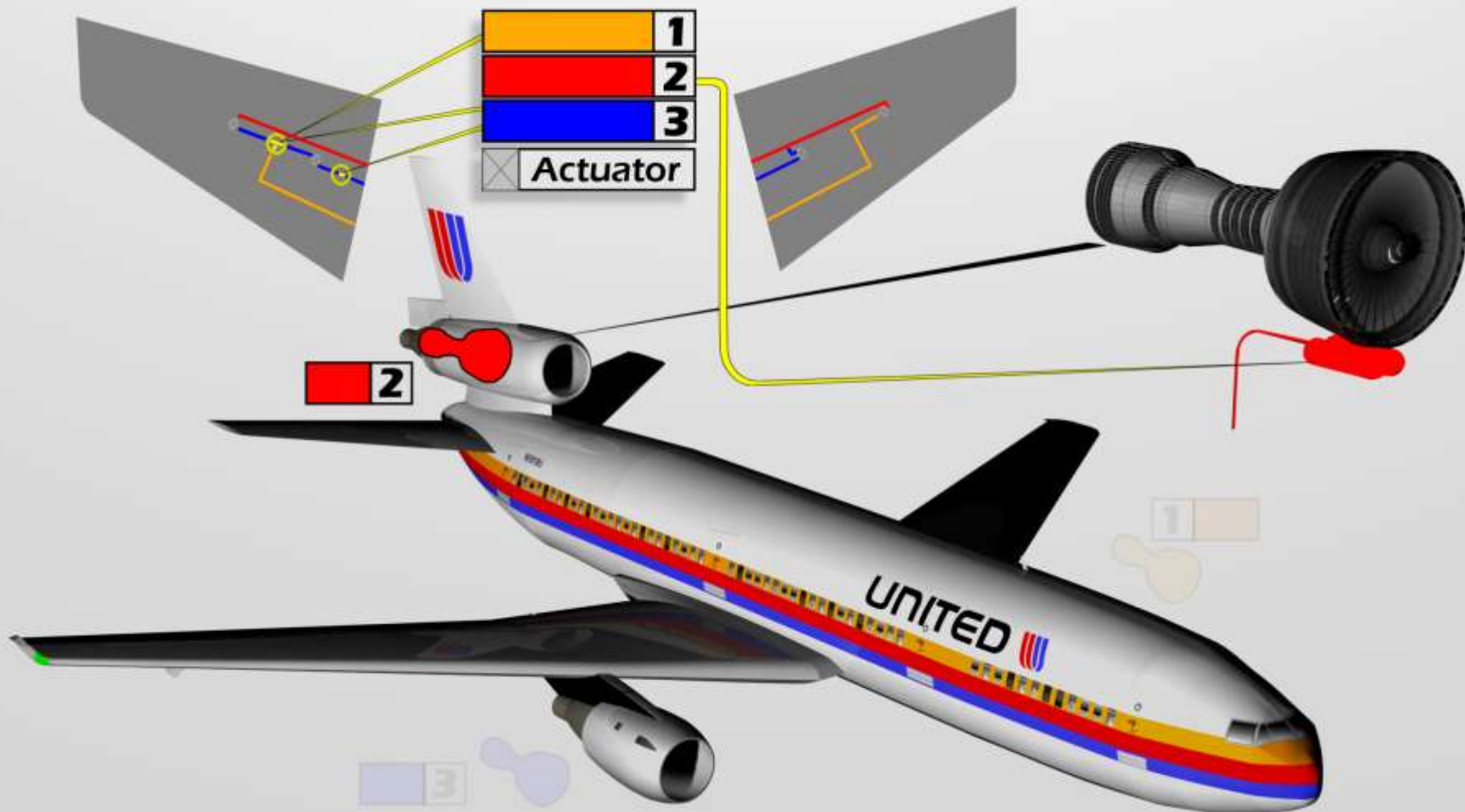


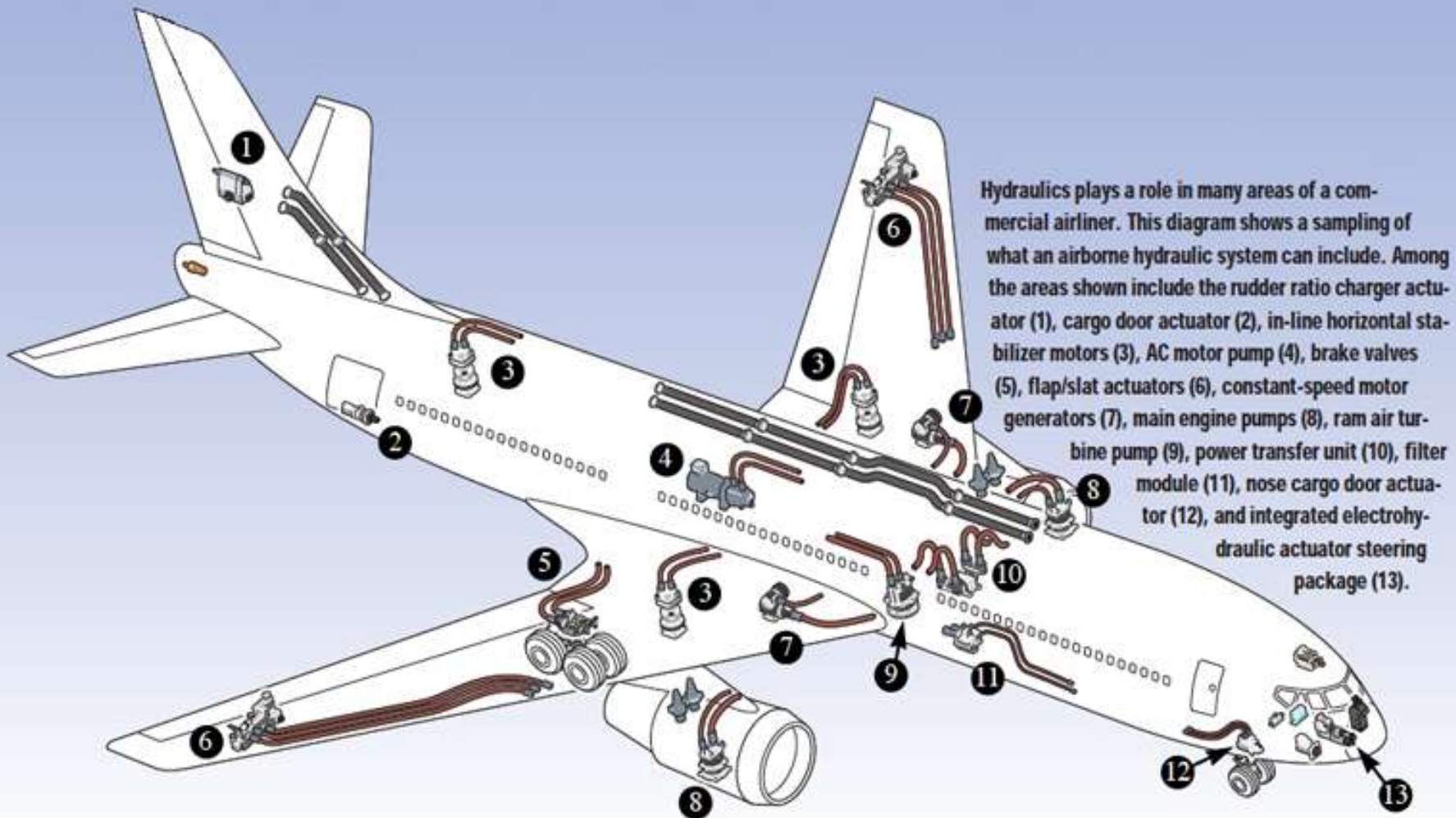
World-Herald

Plane was headed from Denver to Chicago ... It turned around for Sioux City after developing problems over Iowa.

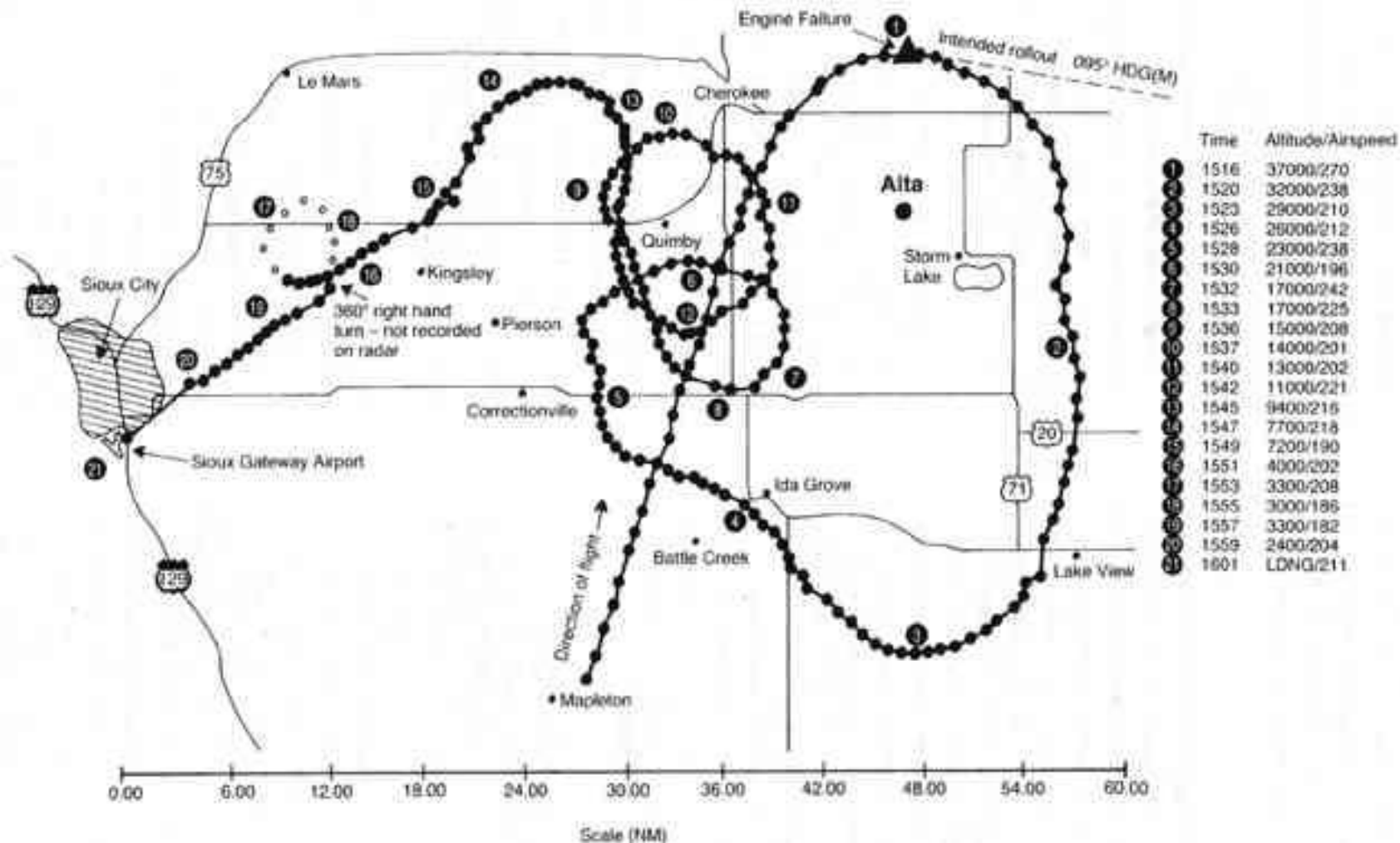


# Damaged hydraulic systems

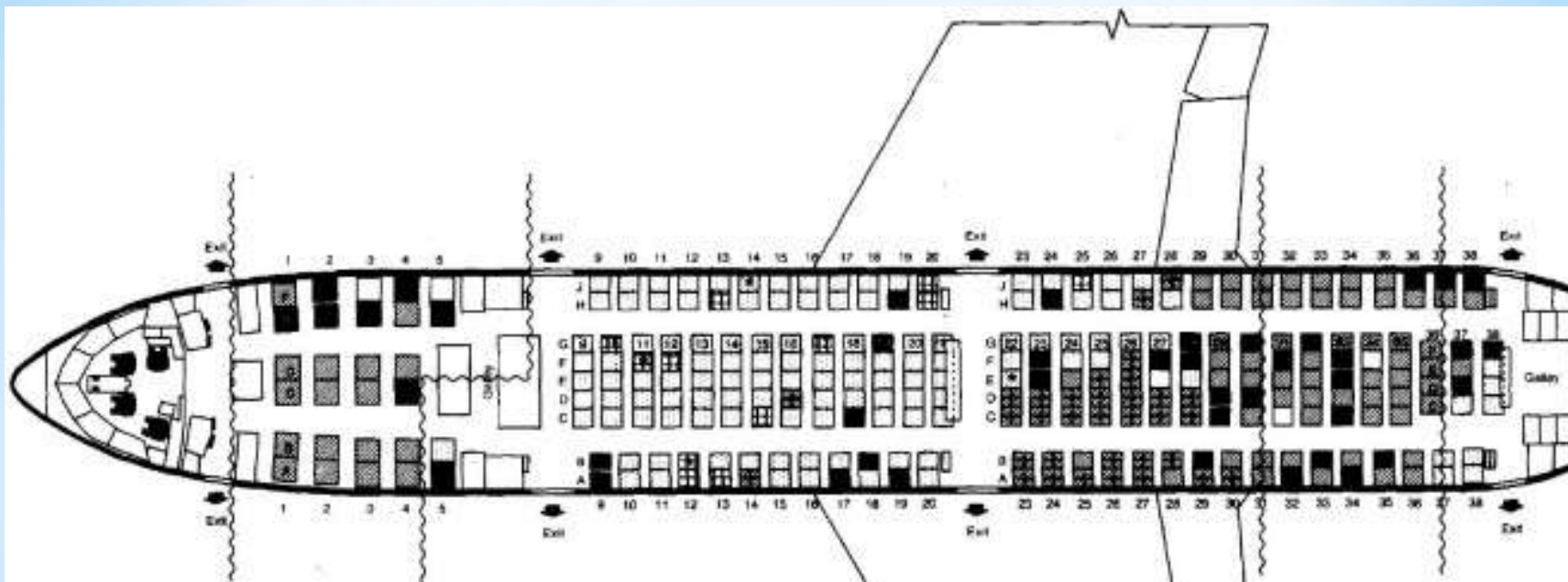




# Ground Track from Radar Plot







Injury Legend	
Fatal	Minor
Fatal (smoke inhalation)	None
Serious	Unoccupied seat

~~~~~ Approximate breaks in fuselage

\*\*In-lap occupants\*

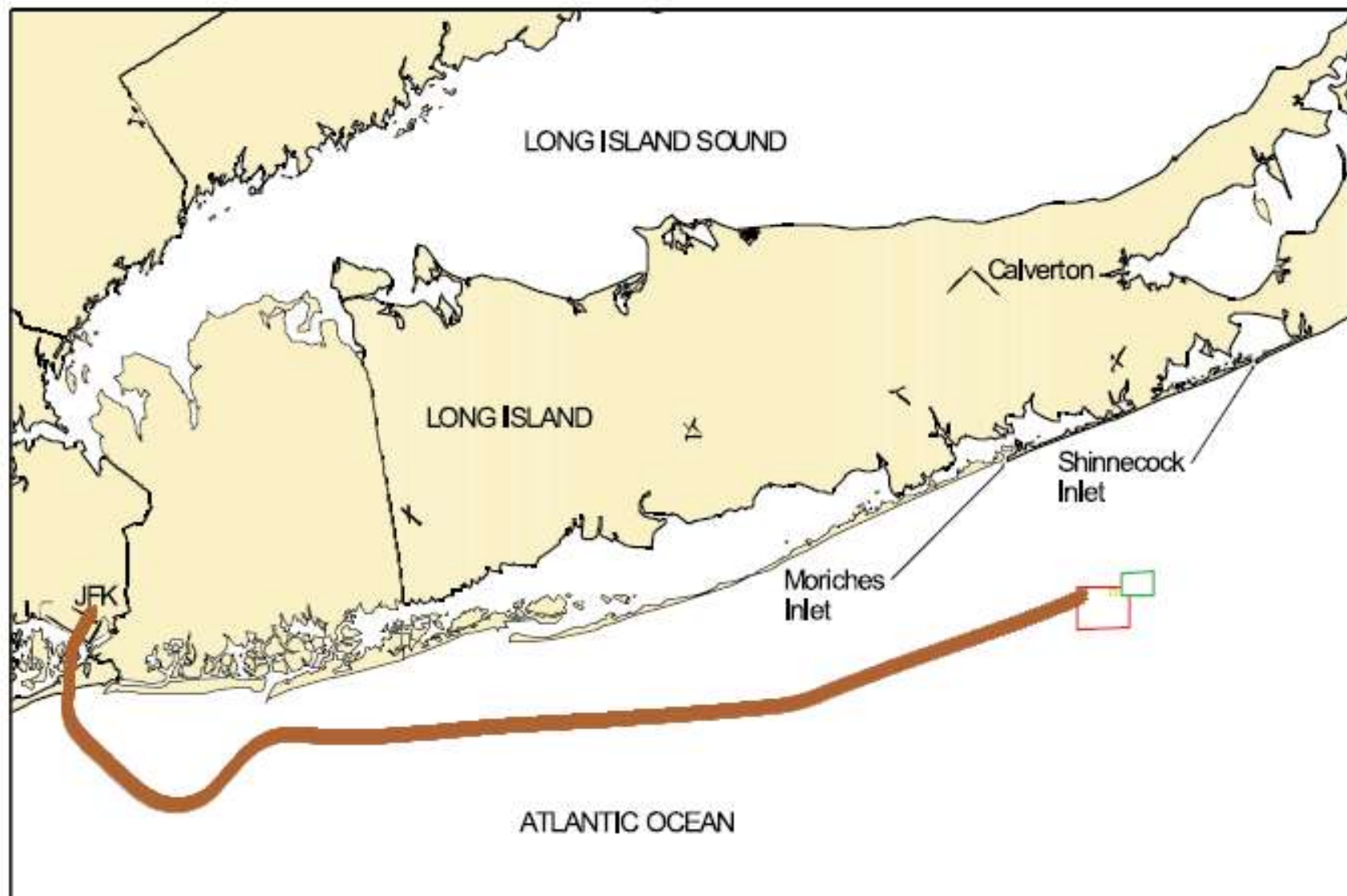
11F    14J

12B    22E

Note:

Passenger who was assigned seat 20H moved to an unknown seat. - - -







## KILL OF TWA FLIGHT 800

hundreds Of Eyewitnesses  
How the FBI and CIA Lied!

**We Saw TWA Flight 800  
Shot Down by Missiles  
And We Won't Be Silenced Any Longer**

...new wave of the hundreds of eyewitnesses to the crash of TWA Flight 800 that killed 230 people off the coast of New York on July 17, 1996.

...OUTRAGED that the FBI would not let a single one of us testify at the NTSB's public hearing in December. It found it necessary to what may have happened to the plane. The FBI feared that our testimony would reveal the CIA, that was shown on national television to purchase weapons that we all knew the plane was shot down. They want you to believe that a fuel tank explosion caused the crash. These fabrications are the only way they can keep the truth hidden.

and strike: An  
burst inside a/c  
(EM missile)  
odes fumes in  
y gas tank



Photos of Soviet EM missiles  
on shuttle launch.

- Pilot eyewitnesses, multiple aircraft.
- Radar "tracked" a nonsolid blip that closed with the aircraft.
- Explosives ruled out.
- Significantly differs from downing by a light SAM at envelope of its range.
- Simple mechanical failure does not fit.

Emulation of surface-to-air missile  
(part of deception plan)

- 1985 eyewitness of similar EM missile strike on Arrow DC-8 at Gander AFB, Newfoundland.
- Multiple photos of EM missile tests over Western Australia ( range).
- Possible: U-2 explosion 7 Aug 96.
- C-130 crash 22 Nov 96.

Emulation of a "leaking fuel"  
explosion (deception plan)

\*Conspiracy Theory







# Reconstructing the Crash

The National Transportation Safety Board's version of how TWA Flight 800 exploded on July 17, 1996.

A. 8:31:11: Center fuel tank explodes

B. 8:31:16: Plane begins to bank to the left. One second later, the front section of the plane breaks off and begins its descent toward earth. The fuselage section of the plane continues on the bank to the left and is pushed upward.

C. 8:31:25: The fuselage rolls to the right and six seconds later begins to fall toward the water.

Where some middle portions of fuselage fell

Where front section of plane landed

Where fuselage landed

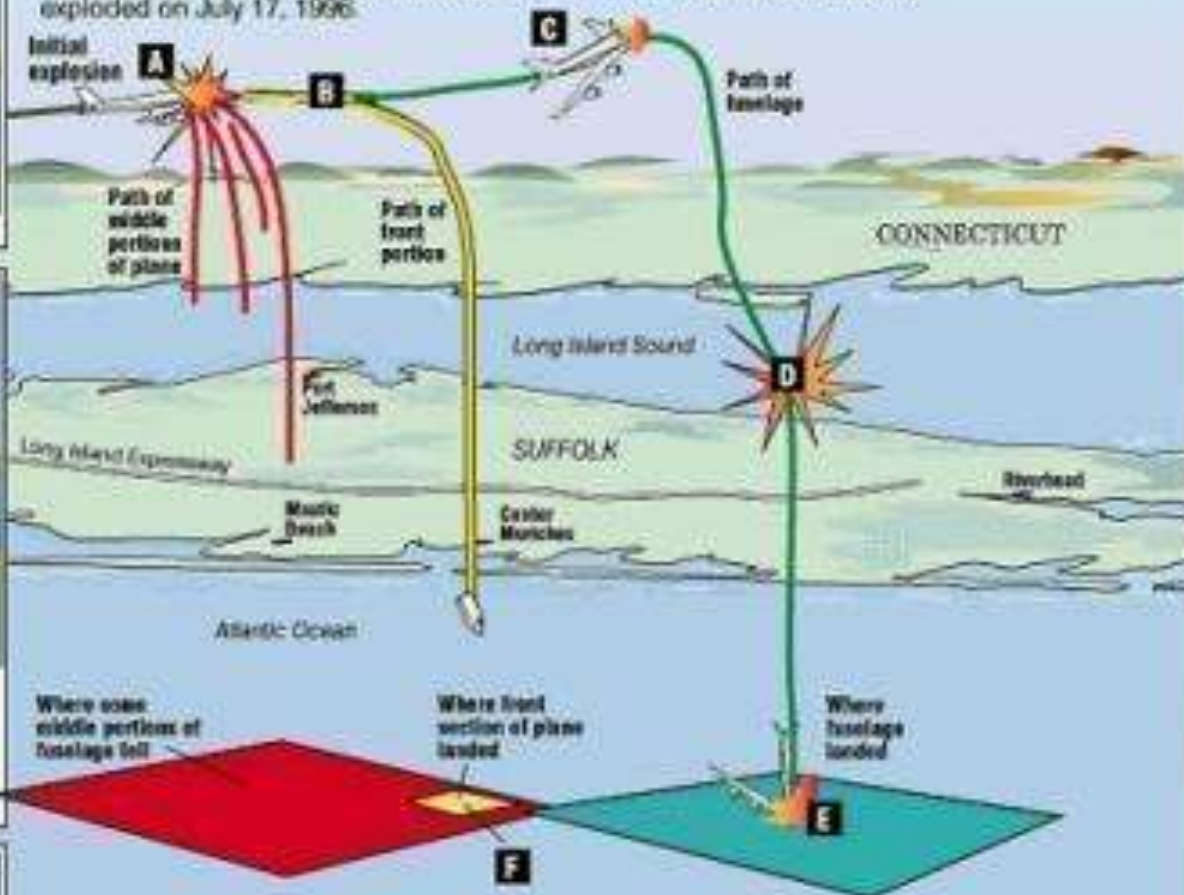
D. 8:31:53: Fireball erupts on the fuselage as the left wing breaks away.

E. 8:32:05: Fuselage hits water.

F. 8:32:50: Front section of the plane hits the water.



Site of crash





# TWA Flight 800

## 4 Years of Mystery

Though the plane wreckage was found quickly, the cause of the crash took 4 years to uncover



18 crew members

230  
people

212 passengers

Paris, France

Atlantic Ocean

New York City, US

TWA

TRANS WORLD

The conclusion: likely faulty wiring that caused the fuel tank to explode

# The international search for Air France 447

*Military planes and ships from Brazil, France and the US are combing the suspected crash area*





# In Free Fall

The last minutes of flight AF 447  
from Rio de Janeiro to Paris



## 2.09 am GMT

The Airbus A330 has been flying through a storm front at an altitude of 10,700 meters (35,100 feet) for more than half an hour.

## 2.10 am

Ice crystals from the clouds block the pitot probes underneath the cockpit. The airspeed display stops working. Several warning signals appear on the control screens in the cockpit. The autopilot and the automatic throttle stop working. The flight computer switches to emergency control (a mode known as Alternate Law 2).



## 2.11 am

The pilots lose control of the aircraft. It is possible that a so-called deep stall occurred at this point.



## 2.12 am

The out-of-control aircraft hurtles toward the ocean surface at an estimated speed of descent of 2,500 meters per minute.

## 2.13 am

The pilots are believed to have desperately tried to restart the flight computer in an attempt to regain control of the airplane.

## 2.14 am

The ground proximity warning system alerts the pilots when the aircraft descends below 600 meters above the ocean surface. Acoustic warnings sound in the cockpit: "Terrain! Terrain! Pull up! Pull up!"

## Impact

The plane, which is still intact, hits the ocean surface with a force equivalent to 36 times the force of gravity and with its nose raised by only five degrees. The vertical stabilizer becomes detached and flies forward.



## Functionality of the Pitot Tube

- 1 The speed of the aircraft determines the pressure of the air stream in contact with the pitot tube. A sensor measures the total pressure.
- 2 The air pressure around the pitot tube (known as the static pressure) is also measured.
- 3 The difference between the total pressure and the static pressure is used to calculate the airplane's speed. The speed is shown on a display in the cockpit.
- 4 When the opening of the pitot tube freezes over, neither pressure nor difference can be measured.



# AIRFRANCE / FLIGHT 447



01:55:57am

Capt. Dubois goes on scheduled break, leaving two co-pilots in charge in the cockpit.

02:10:05am

Pitot tubes freeze. Air speed indicator goes haywire. Auto-pilot disconnects. Co-pilot Bonin now flying the plane.

02:10:07am

Co-pilot Bonin makes disastrous decision to pull the nose of the plane up. Plane starts to climb rapidly, which soon leads to aerodynamic stall.

02:10:11am

First stall warning. Nose is still up, vertical speed increasing.

02:11:22am

Top of the rollercoaster. The plane stalls, starts to fall out of the sky—dropping at 10,000 feet per minute.

02:11:43am

Capt. Dubois re-enters the cockpit. Says to Bonin. "What are you [expletive deleted] doing?" No one acknowledges the plane is in a stall.

02:12:30am

Co-pilot Bonin says: "Am I going down now?" Apparently so discombobulated he has no idea whether the plane is going up or down.

02:13:23am

Computer's synthetic voice announces "dual input" in the cockpit—the two copilots are putting contradictory inputs into their respective control sticks.

02:14:14am

Synthetic Voice: "Pull up!" But it is too late. Co-pilot Robert's last words: "We're going to crash. I can't believe it."

02:14:28 am

Air France 447 hits the water.







# FATAL AIRLINE DISASTERS SINCE MARCH 8, 2014



|   | AIRLINE           | FLIGHT  | PLANE       | CAUSE*                 | DEATHS         |
|---|-------------------|---------|-------------|------------------------|----------------|
| 1 | Malaysia Airlines | #MH370  | Boeing 777  | Missing, cause unknown | 239            |
| 2 | Malaysia Airlines | #17     | Boeing 777  | Unlawfully shot down   | 298            |
| 3 | TransAsia Airways | #222    | ATR 72-500  | Inclement weather      | 48             |
| 4 | Air Algerie       | #AH5017 | MD-83       | Malfunction            | 116            |
| 5 | Sepahan Airlines  | #5915   | Antonov 140 | Malfunction            | 39             |
| 6 | AirAsia           | #QZ8501 | A320        | Engine stall           | 162            |
| 7 | TransAsia         | #235    | ATR 72-600  | Engine failure         | 38             |
| 8 | Germanwings       | #9525   | A320        | Under investigation    | 150 (presumed) |

\*Causes presumed, most cases still under investigation



# Flight MH370



# TIMELINE OF MISSING MH370



- 12.41am** ▶ MH370 departs KLIA
- 02.40am** ▶ Subang Air Traffic Control loses contact with MH370
- 06.30am** ▶ MH370 scheduled to land in Beijing International Airport, never arrives
- 07.24am** ▶ MAS confirms MH370 missing
- 08.30am** ▶ Estimated time of fuel depletion on MH370
- 09.00am** ▶ MAS begins contacting next-of-kin
- 10.44am** ▶ MAS denies rumour MH370 made emergency landing at Nanming, China
- 01.46pm** ▶ Vietnamese media reports MH370 crashed near Tho Chu Island
- 02.30pm** ▶ Transport minister denies crash report, says awaiting military confirmation

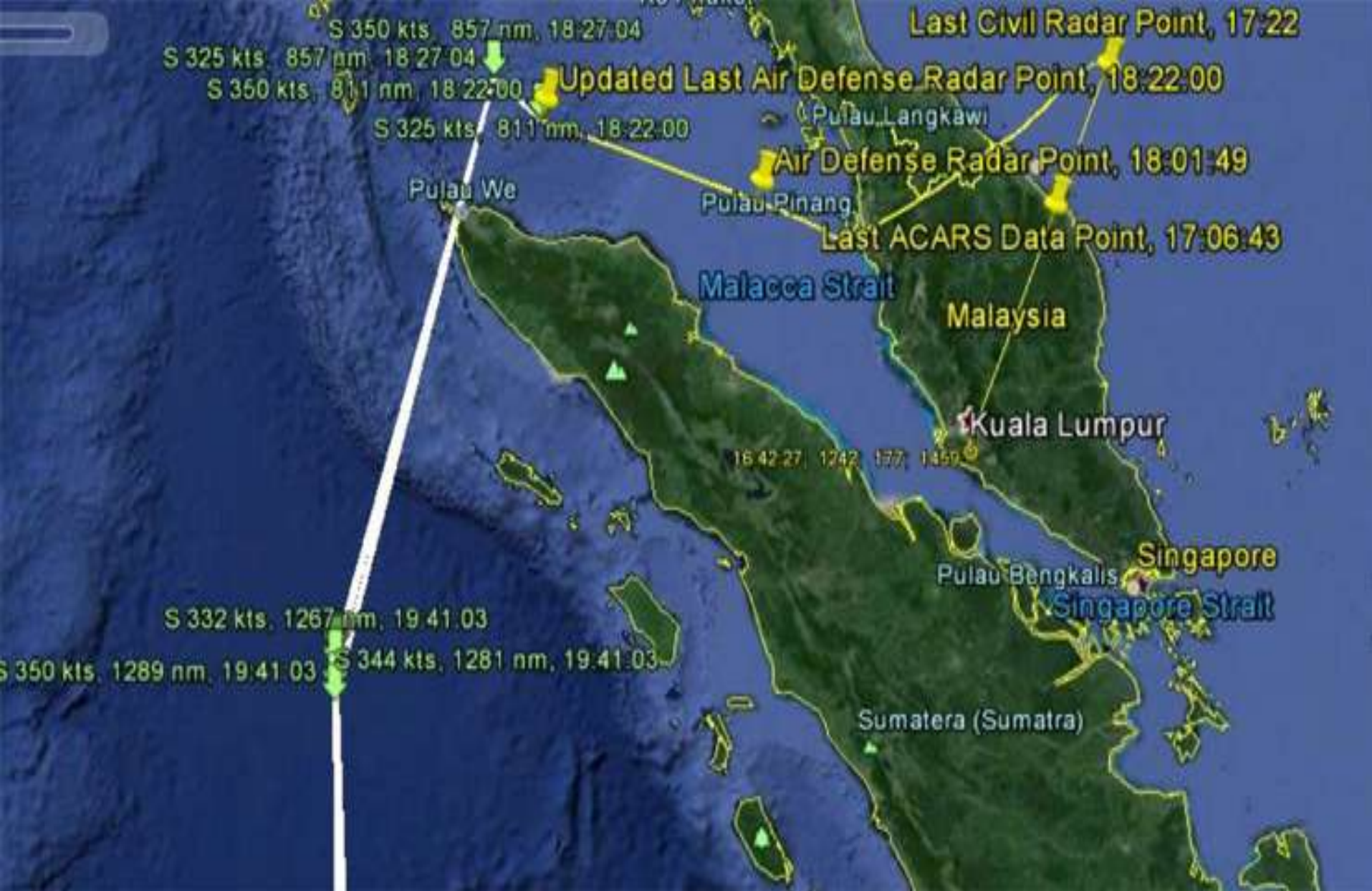




Timeline of disappearance [\[edit\]](#)

| Duration<br>(HH:MM) | Time  |       | Event                                                                                                           |
|---------------------|-------|-------|-----------------------------------------------------------------------------------------------------------------|
|                     | MYT   | UTC   |                                                                                                                 |
| 00:00               | 00:41 | 16:41 | Take-off from Kuala Lumpur                                                                                      |
| 00:20               | 01:01 | 17:01 | MH370 confirms altitude of 35,000 feet (11,000 m) <sup>[24]</sup>                                               |
| 00:26               | 01:07 | 17:07 | Last ACARS data transmission received, <sup>[25]</sup> MH370 reconfirms altitude of 35,000 feet <sup>[24]</sup> |
| 00:38               | 01:19 | 17:19 | Last Malaysian ATC voice contact: "All right, good night" <sup>[23]</sup>                                       |
| 00:40               | 01:21 | 17:21 | Last secondary radar (transponder) contact at 6°55'15"N 103°34'43"E                                             |
| 00:41               | 01:22 | 17:22 | Transponder and ADS-B now off                                                                                   |
| 00:49               | 01:30 | 17:30 | Unsuccessful voice contact from another aircraft, mumbling/static audible <sup>[19]</sup>                       |
| 00:56               | 01:37 | 17:37 | Missed expected half-hourly ACARS data transmission <sup>[25]</sup>                                             |
| 01:30               | 02:11 | 18:11 | First of seven automated hourly ACARS contacts with Inmarsat 3F1 satellite                                      |
| 01:34               | 02:15 | 18:15 | Last primary radar contact by Malaysian military, 200 miles (320 km) NW of Penang                               |
| 05:49               | 06:30 | 22:30 | Missed scheduled arrival in Beijing                                                                             |
| 07:30               | 08:11 | 00:11 | Last automated hourly ACARS contact with Inmarsat satellite <sup>[26][27]</sup>                                 |
| 07:49               | 08:30 | 00:30 | Reported missing <sup>[28]</sup>                                                                                |









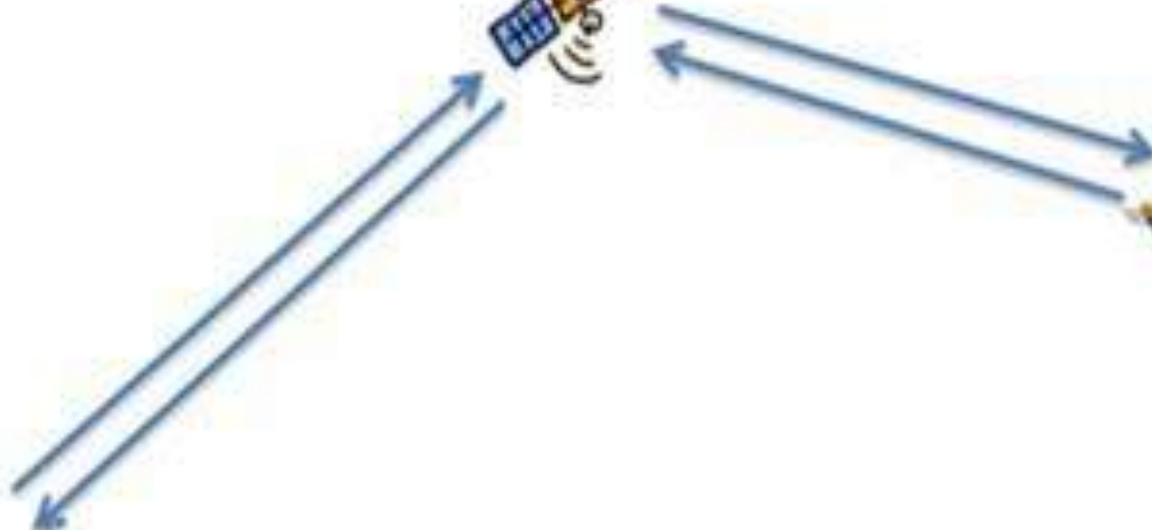
Inmarsat 3  
IOR Satellite



Aircraft



Inmarsat Land Earth Station  
Perth (Australia)





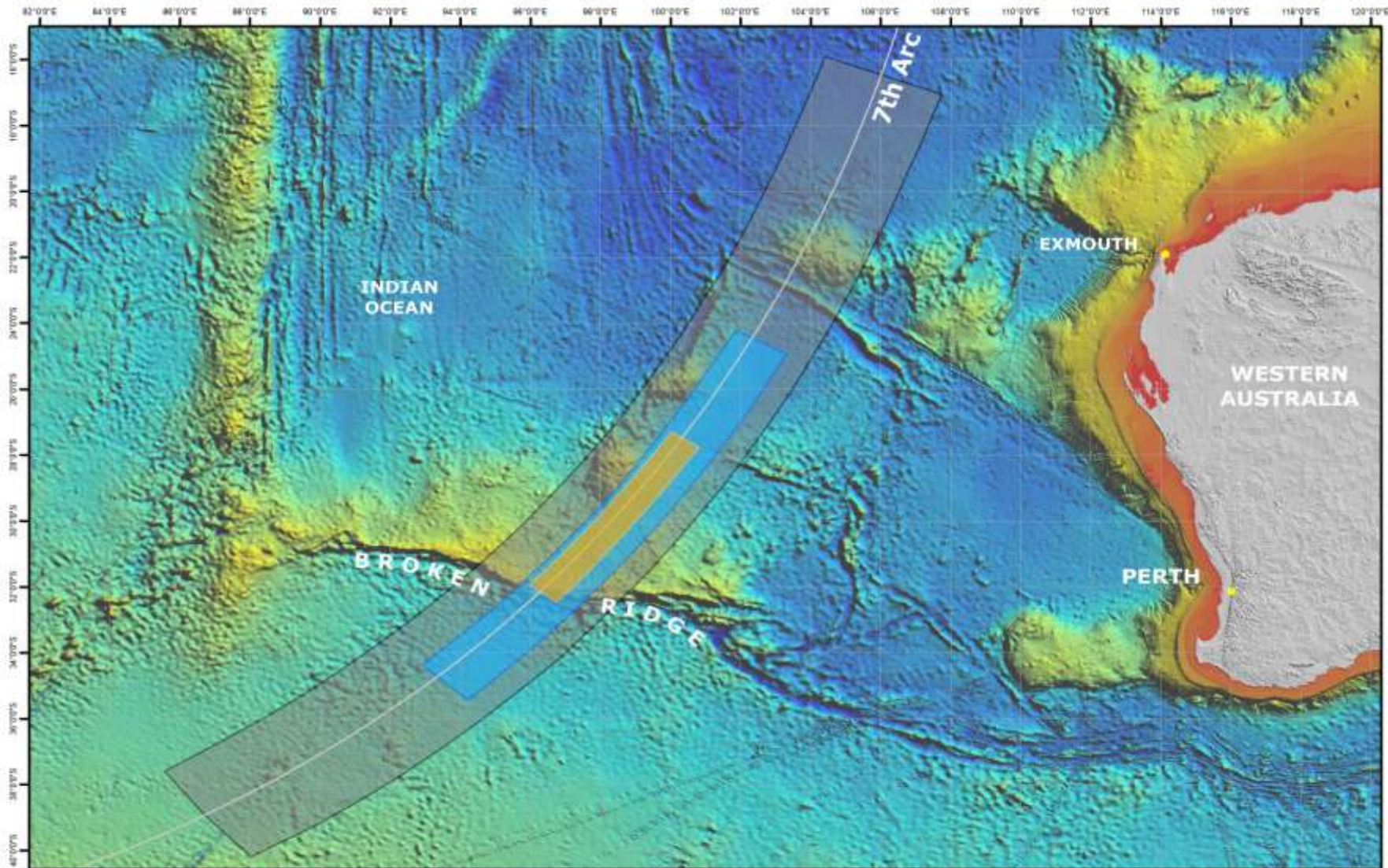
**Satellite**

35,800 km above sea level

Last radar  
contact with  
MH370

Last known possible  
position of MH370  
based on satellite data  
(somewhere on red lines)





### MH370 Underwater Search Areas Planning Map

0 250 500 Kilometres  
 Background image: Australian Bathymetry and Topography Grid  
 (June 2009) <http://www.ga.gov.au/research/ANZCW0731013118.html>

#### MH370 Underwater Search Planning Areas

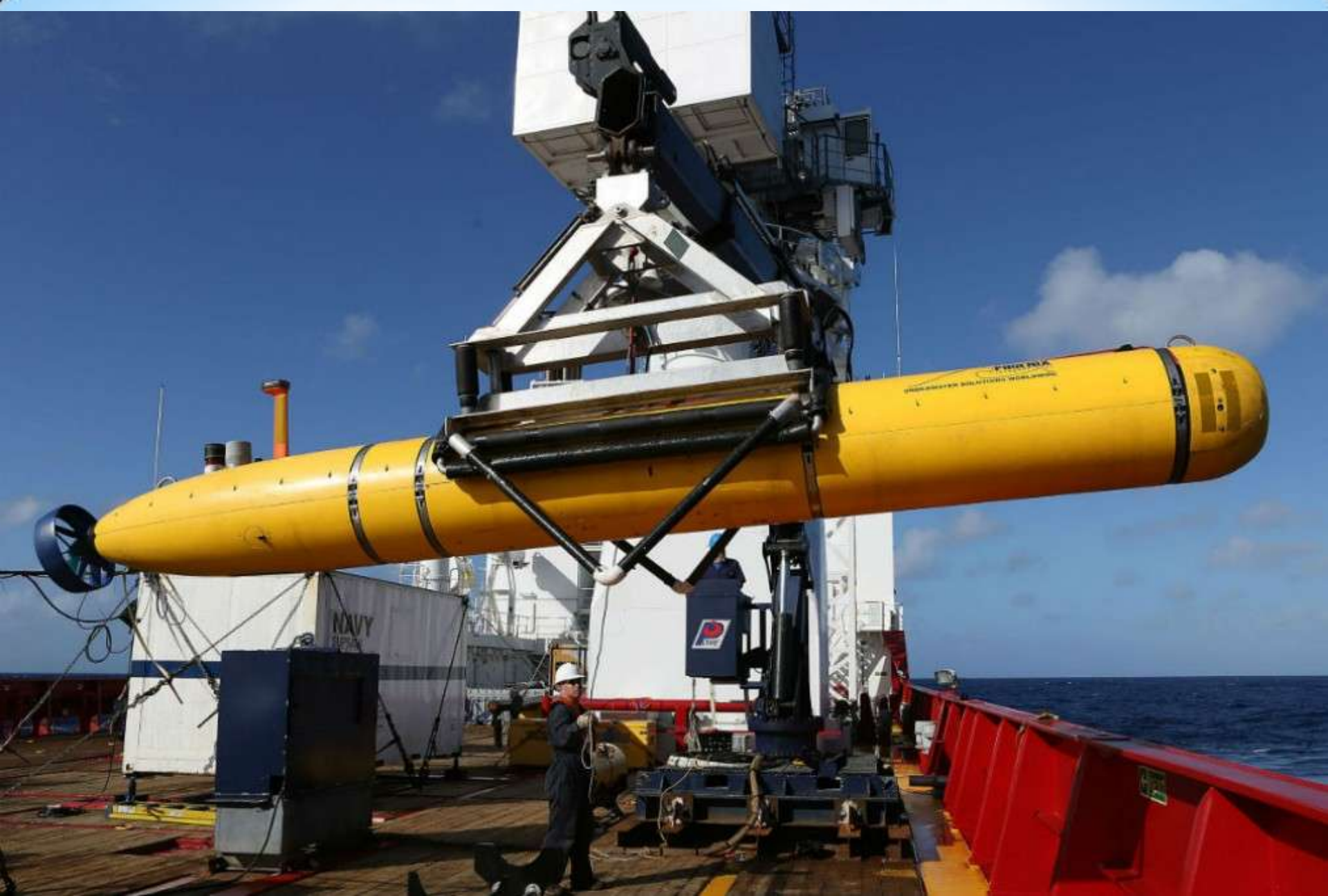
- 1. Priority search area
- 2. Medium search area
- 3. Wide search area

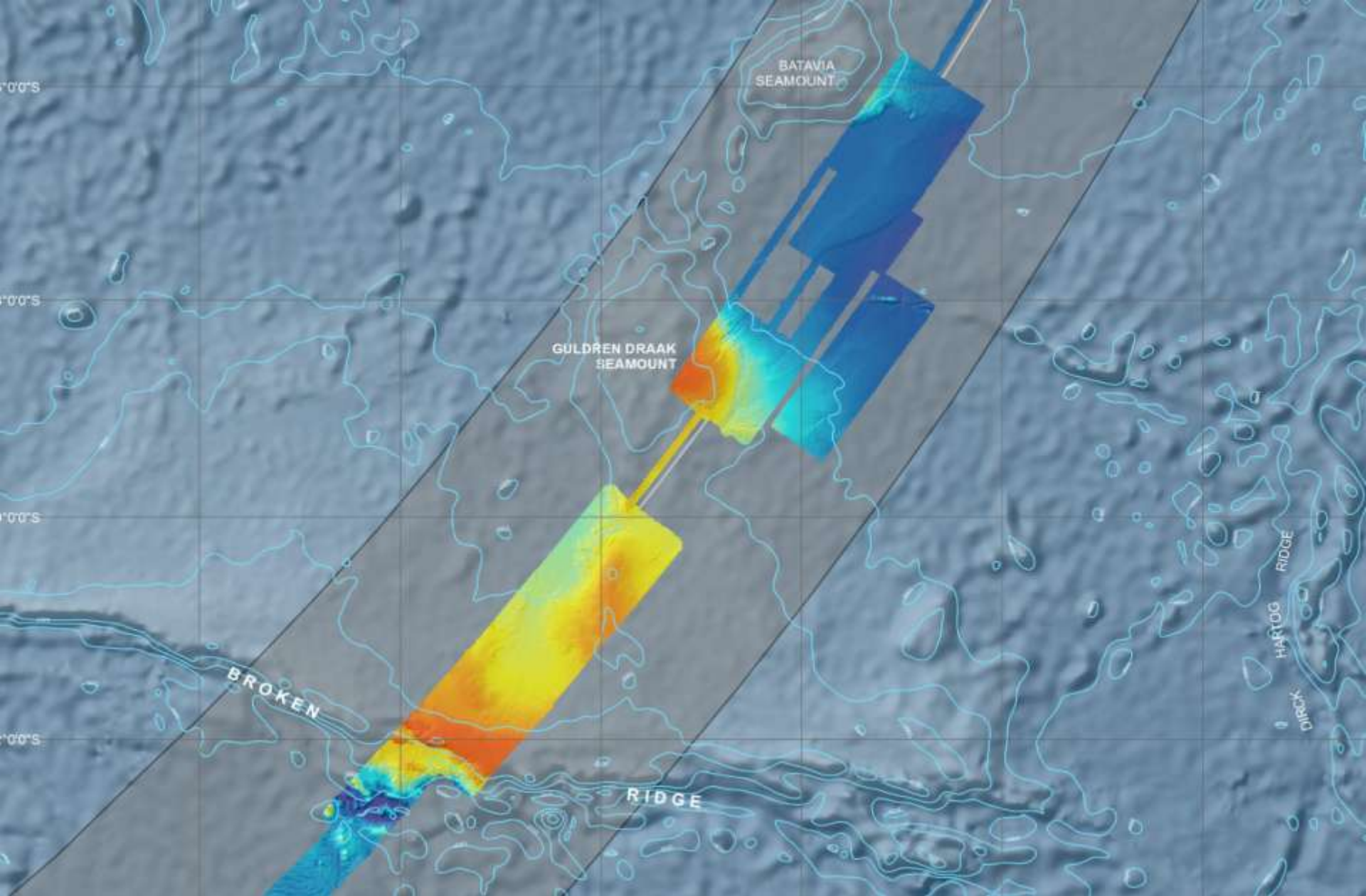
Bathymetry  
 Elevation Ramp  
 0 m  
 -2000 m  
 -4000 m  
 7185 m  
 approx.



N  
 Date: 2014/06/24  
 Map Number: 2014011

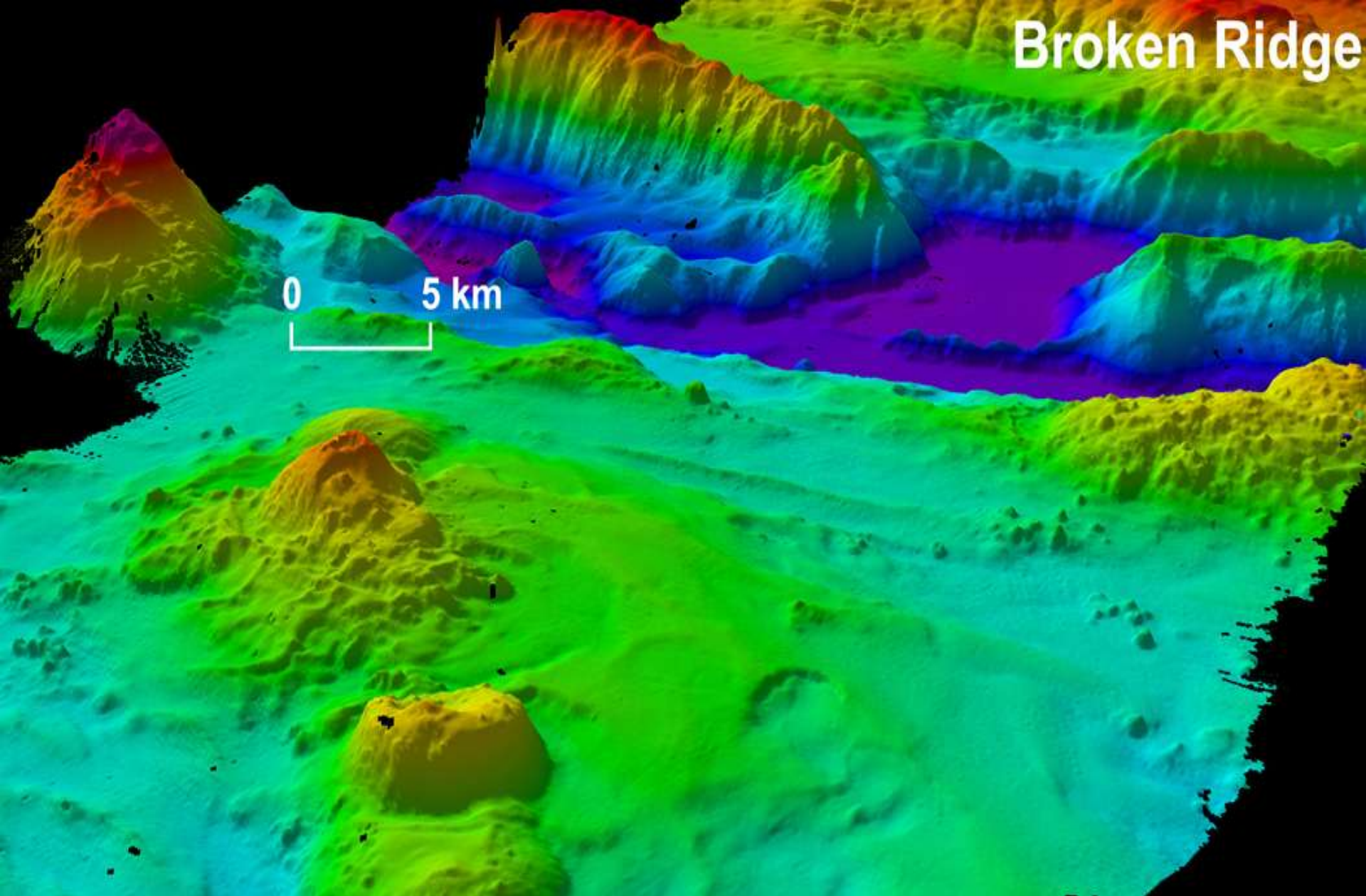








# Broken Ridge



# \* How can we be so sure?

- \* Inmarsat checked all Malaysia Airlines 777s satellite signals in the days and weeks after
- \* It also checked the historical data of this particular Boeing 777 and examined its unique signature
- \* The data has been checked and rechecked over months
- \* Five independent teams have arrived at the same most likely crash area







- \* French experts say it is a "certainty" that the jet wing part that washed up on the Indian Ocean island of Reunion is from the missing Malaysia Airlines flight MH370.
- \* In a statement in Paris yesterday, senior French prosecutor Francois Molins said that a series of numbers found inside the barnacle-crusted 'flaperon' matches records held by a Spanish manufacturer as being part of the Boeing 777, last seen on 8 March last year.
- \* According to CNN the statement added: "Consequently, it is possible today to affirm with certainty that the flaperon discovered at the Reunion Island on July 29 2015 is that of MH370."
- \* Malaysia's prime minister, Najib Razak, said in August that he believed the flaperon must be from the missing aircraft, says the BBC. But this is the first official confirmation from France, where the part was taken for analysis.
- \* The 6ft-long chunk of metal was found on the French territory of Reunion some 2,300 miles from the area where searchers believe the jet must have crashed into the ocean - but the find is consistent with projections about where debris might end up after drifting on ocean currents.
- \* MH370 took off from Kuala Lumpur in the early hours of 8 March 2015, heading for Beijing with 239 passengers and crew on board.
- \* The hunt for the wreckage continues in the southern Indian Ocean, 1,100 miles off the coast of Australia, with some 30 per cent of the top-priority search area covered so far using sonar technology.
- \* The area searched is more than 11,185 square miles of the ocean floor, says the BBC, at depths of nearly 20,000 feet.

\* **September 4, 2015**

# Malaysia Airlines flight 17 (MH17)

Amsterdam - Kuala Lumpur (AMS - KUL)

## AIRCRAFT TYPE

Boeing 777-200ER

## REGISTRATION NUMBER

9M-MRD

## CONSTRUCTION NUMBER

28411



## LINE NUMBER

84

## FIRST FLIGHT

April 17, 1997

## AGE

17 years

## ENGINES

Rolls-Royce Trent 892

SOURCE: PlaneFinderData

GRAPHICS: themalaymailonline.com





Amsterdam

Deutschland  
Germany

Poland

Україна  
Ukraine

Donetsk

România  
Romania

Kyjev

Donetsk

Hrabove

Torez

Pelahiivka

Sjeverne

Molchaljne

50km  
Rusko

US Dept of State  
© 2014 Google  
Image Land

Google earth



Protilietadlový  
komplex  
**BUK 9K37**

Raketa váží 690 kg  
hlavice 70 kg  
délka 5,5 metrů  
rychlost 1200 m/s  
Dosah 32 km  
Setřeluje cíle ve  
výšce až 22 km





# THE DOWNING OF FLIGHT MH17



**1** Malaysia Airlines Flight MH17 takes off from Amsterdam's Schiphol Airport at 12.15pm local time destined for Kuala Lumpur carrying 280 passengers and 15 crew



**4** Shortly before 1.25pm GMT, at 33,000ft, contact with Flight MH17 is lost over a separatist stronghold near the Russian border, suspected of being shot down by Buk missile launcher

**3** The crew are thought to have been aware of a no-fly zone covering Crimea and south-eastern Ukraine implemented by the International Civil Aviation Organisation



**2** The Boeing 777-200ER passes over Germany and Poland before crossing into Ukraine

## Buk 9K37 MISSILE SYSTEM

(NATO codename SA-11 Gadfly)

- Introduced in 1980 by the Soviet Union
- Designed to shoot down cruise missiles, drones and aircraft
- Four missiles mounted on tracked chassis



- Each missile 18ft long with 70kg warhead
- Has a 20 mile range and maximum altitude of 13 miles (72,000ft)
- Missiles fired at 1,900mph and guided by radar station on ground

# Buk-1M air defense system

*The Buk missile system is a mobile launcher equipped with air defense missiles capable of hitting aircraft at high altitudes. Such a launcher was reported seen near where Malaysia Airlines Flight MH17 came down.*

Mobile launcher,  
with radar unit



UKRAINE

9M28M1  
missile



Pro-Russian  
insurgent activity



Reported  
crash site

LUHANSK

UKRAINE

DONETSK

Hrabove

RUSSIA

50 miles

50 km

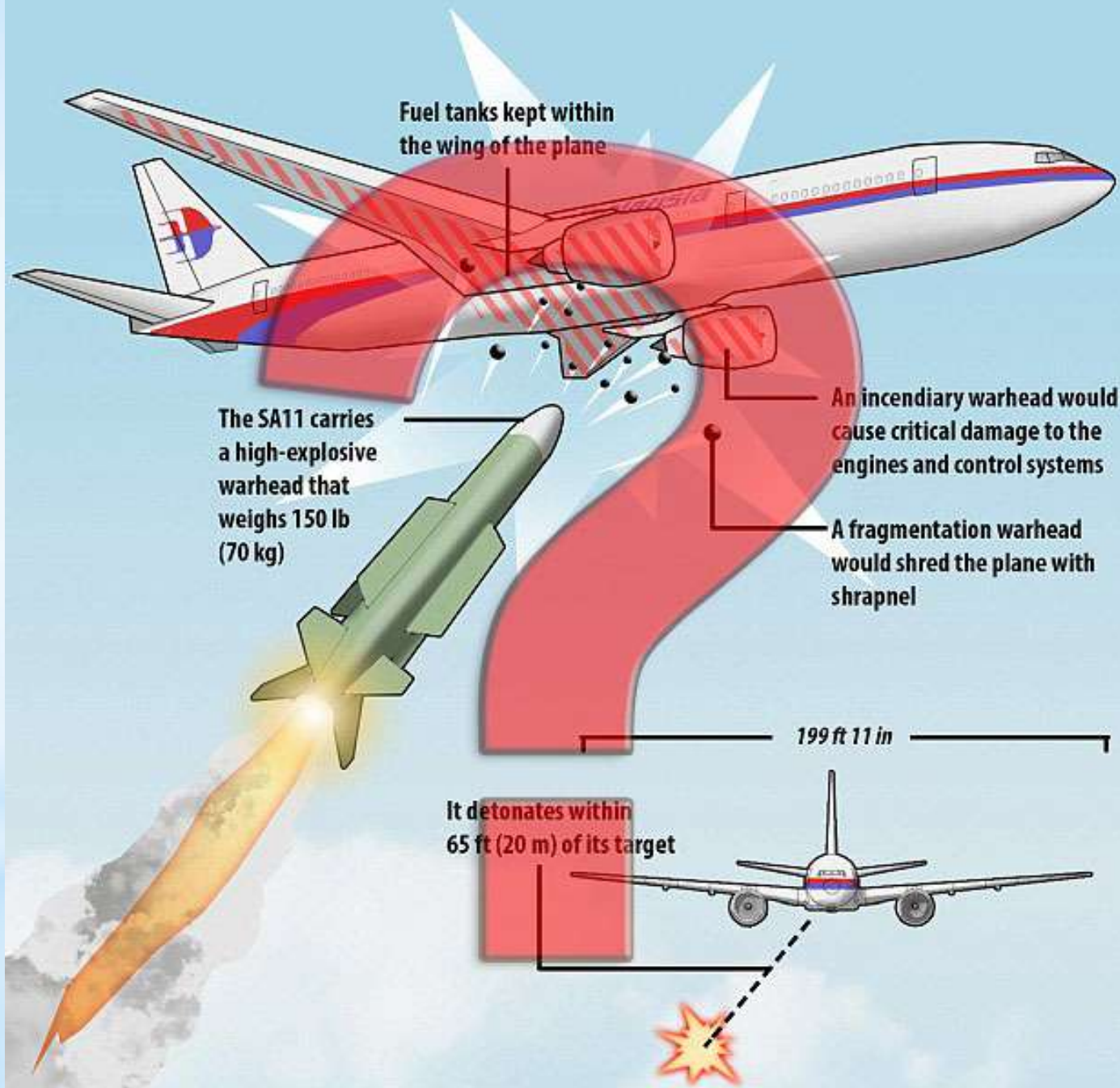
Sea of Azov

- Can fly as high as 46,000 ft. (14,020 m) at Mach 3, 2,284 mph (3,675 kph)
- Fast setup, can go from driving to firing mode in as little as 5 minutes
- Fragmentation warhead
- Buk system has a radial range of about 22 mi. (35 km)



Source: GlobalSecurity.org, AP, NBC News  
Graphic: Robert Dorrell, Melina Yingling  
© 2014 MCT









DUTCH  
SAFETY BOARD

MH17

Final report



The Dutch Safety Board's (DSB) report, released Oct. 13, 2015, concluded that MH-17 was downed on July 17, 2014, by a BUK surface-to-air missile, killing all 298 people aboard. The report contained several recommendations:

- \* ICAO should require that states experiencing conflict on their territory should, “at an early stage,” publish the nature and extent of threats it poses to civil aviation.
- \* ICAO should update its SARPs related to the consequences of armed conflict to civil aviation.
- \* ICAO and IATA should encourage states and operators that have information on threats in foreign airspace to publish it expeditiously.
- \* ICAO should amend its SARPs so that risk assessments cover threats to aircraft flying at cruising altitudes, especially when overflying conflict zones. Uncertainty factors should be included in these risk assessments.
- \* IATA should ensure that standards regarding risk assessments are included in the IATA Operational Safety Audits.
- \* States should require their national airlines to make risk assessments of overflying conflict zones.
- \* ICAO and IATA should introduce a platform where experiences and good practices can be exchanged regarding risk assessments of overflying conflict zones.
- \* IATA airlines should agree on how to present clear information to potential passengers on flight routes over conflict zones.
- \* Operators should provide public accountability for the routes chosen, at least annually.

# \* MH-17 Accident Report

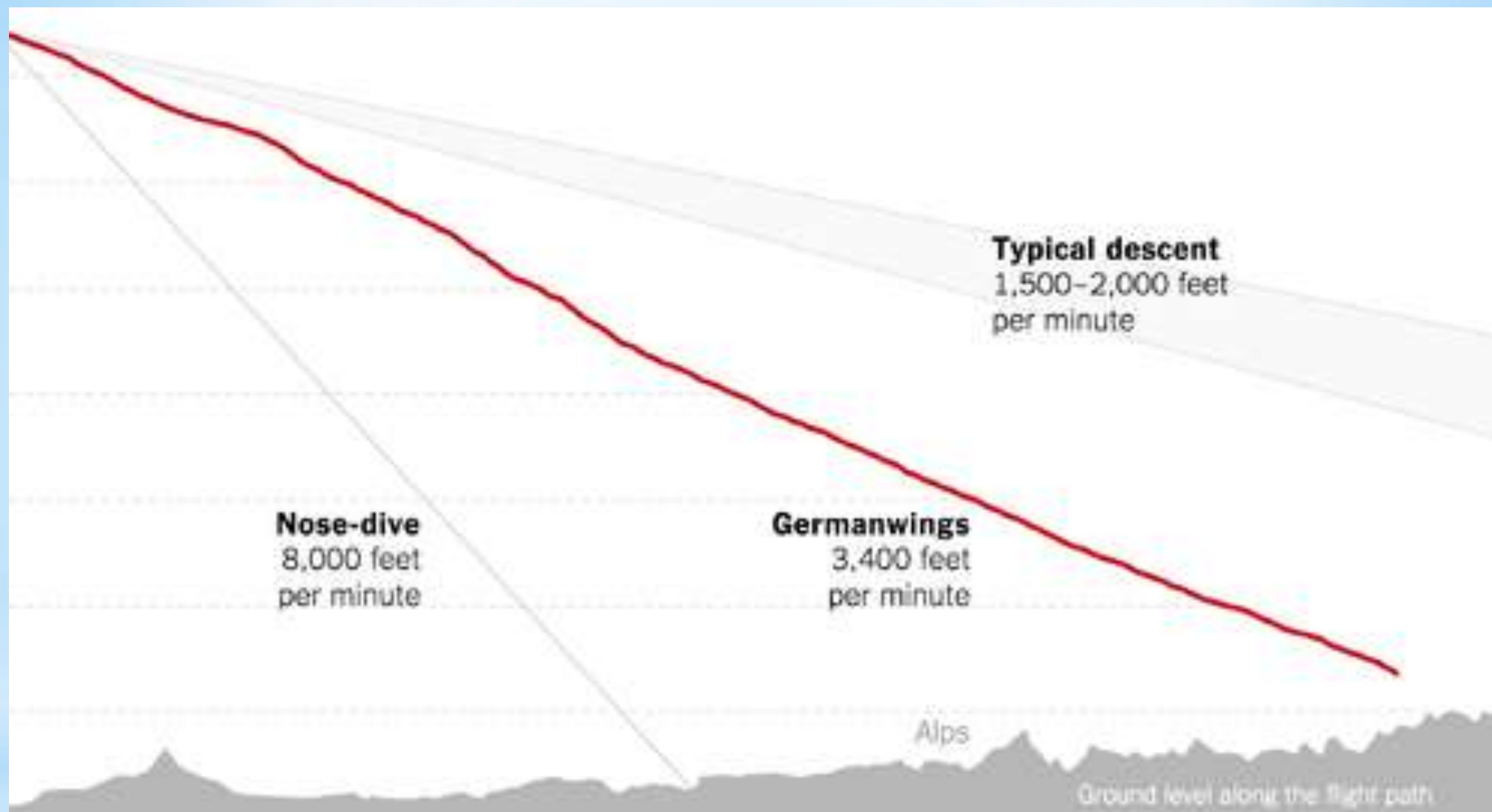
# 5 OTHER PLANES SHOT DOWN BESIDES MH17



# FLIGHT TIMELINE











## **WHAT WE KNOW ABOUT CO-PILOT**

- **28-YEAR-OLD ANDREAS LUBITZ**
- **WAS NOT ON A TERROR LIST**
- **HAD 630 HOURS OF FLIGHT TIME**



## **AirAsia QZ8501 (updated 1.24 PM)**

### **Passengers:**

**1 Malaysian  
1 Singaporean  
3 Koreans  
157 Indonesians**

**138 adults  
16 children  
1 infant  
2 pilots  
5 cabin crew**

### **Crew composition:**

**Captain : Iriyanto  
FO : Remi Emmanuel Plesel**

### **4 Flight Attendants:**

**SFA : Wanti Setiawati  
FA : Khairunisa Haidar Fauzi  
FA : Oscar Desano  
FA : Wismoyo Ari Prambudi  
1 ENG : Saiful Rakhmad**



## WRECKAGE FOUND

SINGAPORE

SUMATRA

KALIMANTAN

Java Sea

LAST CONTACT

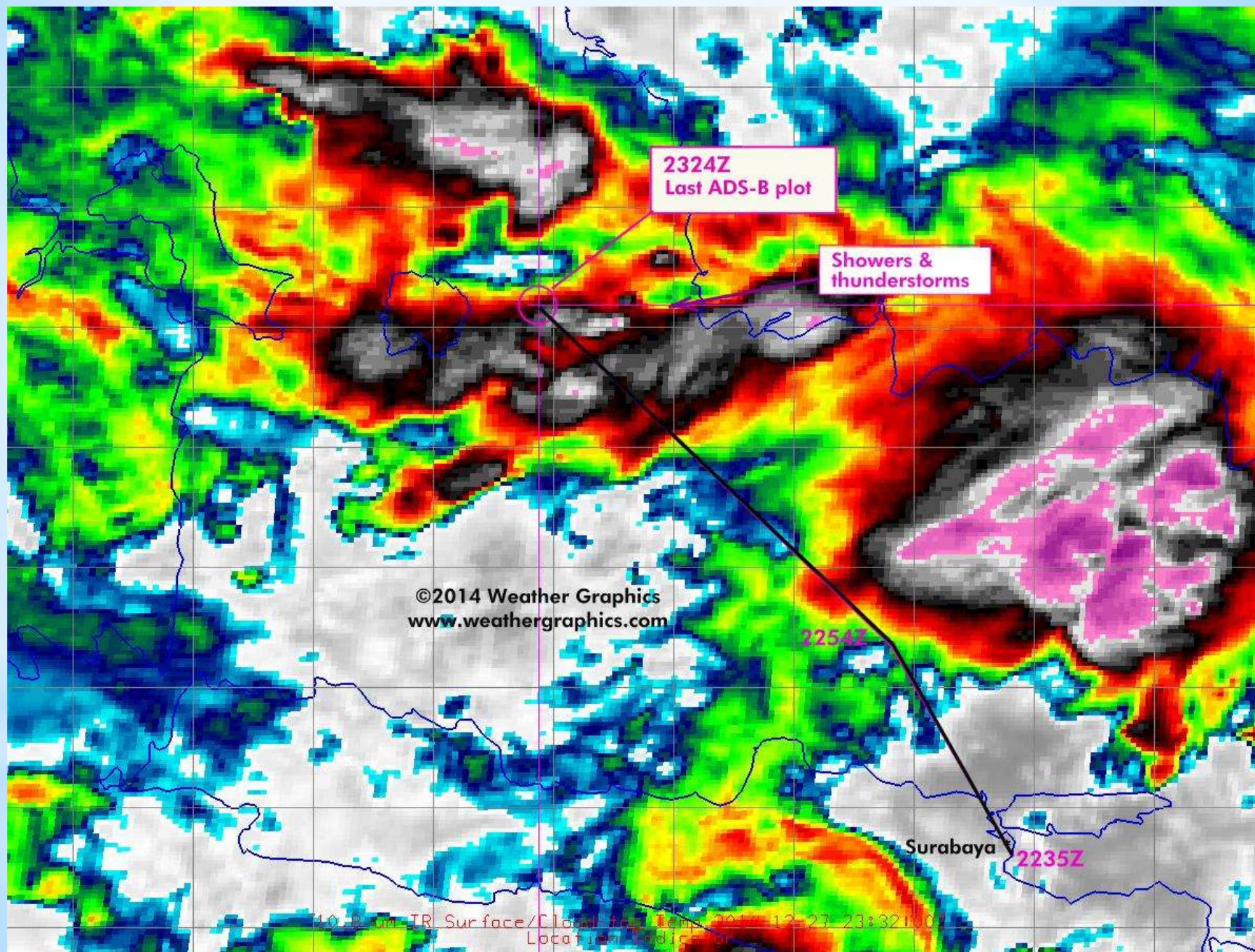
Indian Ocean

JAVA

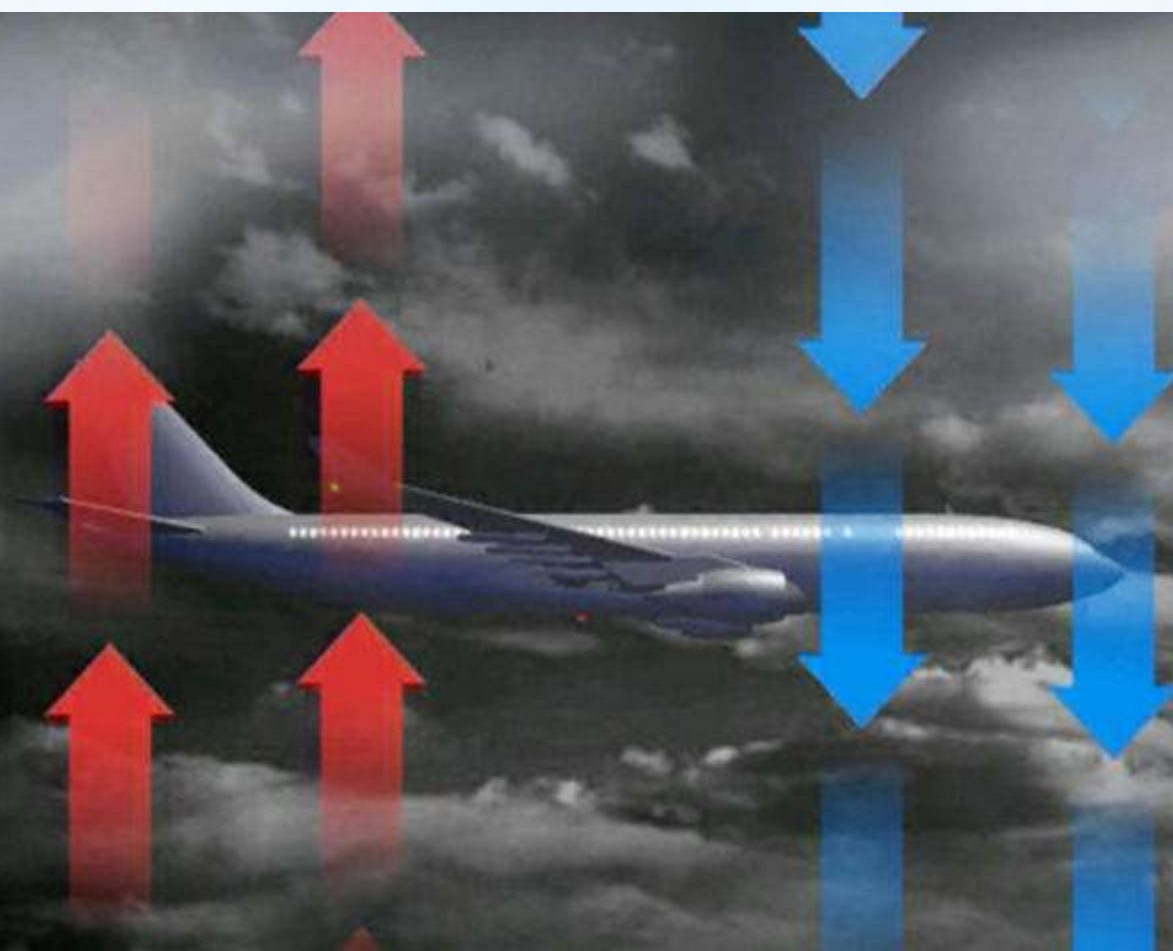
Surabaya









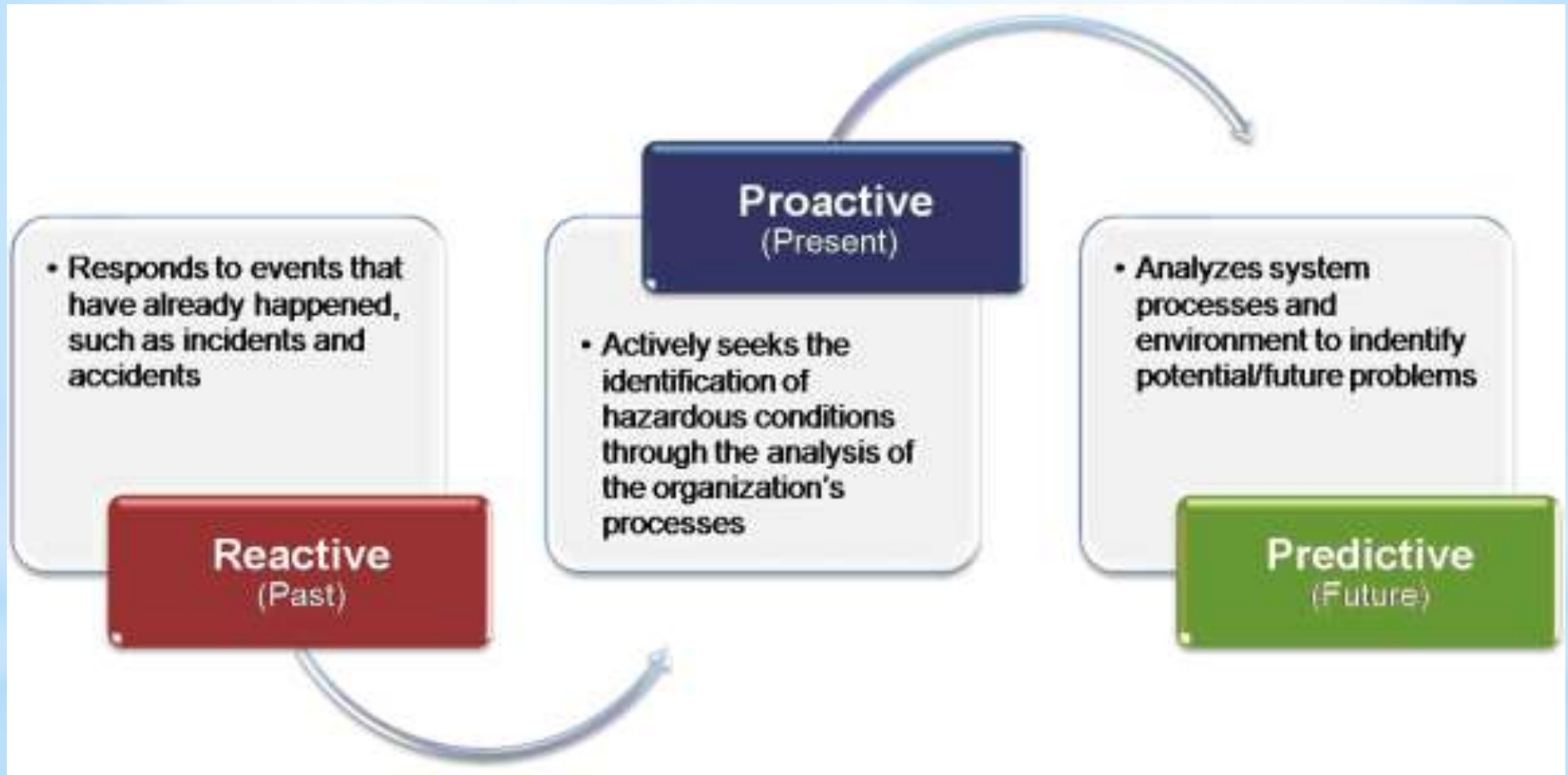


# \* ICAO's Definition of Safety



“The state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management.”

## \* Annex 19 - Safety Management Systems (SMS)



Source: FAA



# \*FRAMEWORK FOR SAFETY MANAGEMENT SYSTEM

An SMS is a management system for the management of safety by an organization. The framework includes four components and twelve elements representing the minimum requirements for SMS implementation:

1. Safety policy and objectives
2. Safety risk management
3. Safety assurance
4. Safety promotion



# The Four SMS Components

## Safety Policy

Establishes senior management's commitment to continually improve safety; defines the methods, processes, and organizational structure needed to meet safety goals

## Safety Assurance

Evaluates the continued effectiveness of implemented risk control strategies; supports the identification of new hazards

## Safety Risk Management

Determines the need for, and adequacy of, new or revised risk controls based on the assessment of acceptable risk

## Safety Promotion

Includes training, communication, and other actions to create a positive safety culture within all levels of the workforce



1.1 Management commitment and responsibility

1.2 Safety accountabilities

1.3 Appointment of key safety personnel

1.4 Coordination of emergency response planning

1.5 SMS documentation



# \* 1. Safety policy and objectives



- \*2.1 Hazard identification
- \*2.2 Safety risk assessment and mitigation



## \*2. Safety risk management

- \* 3.1 Safety performance monitoring and measurement
- \* 3.2 The management of change
- \* 3.3 Continuous improvement of the SMS



## \* 3. Safety assurance

- \* 4.1 Training and education
- \* 4.2 Safety communication



## \* 4. Safety promotion



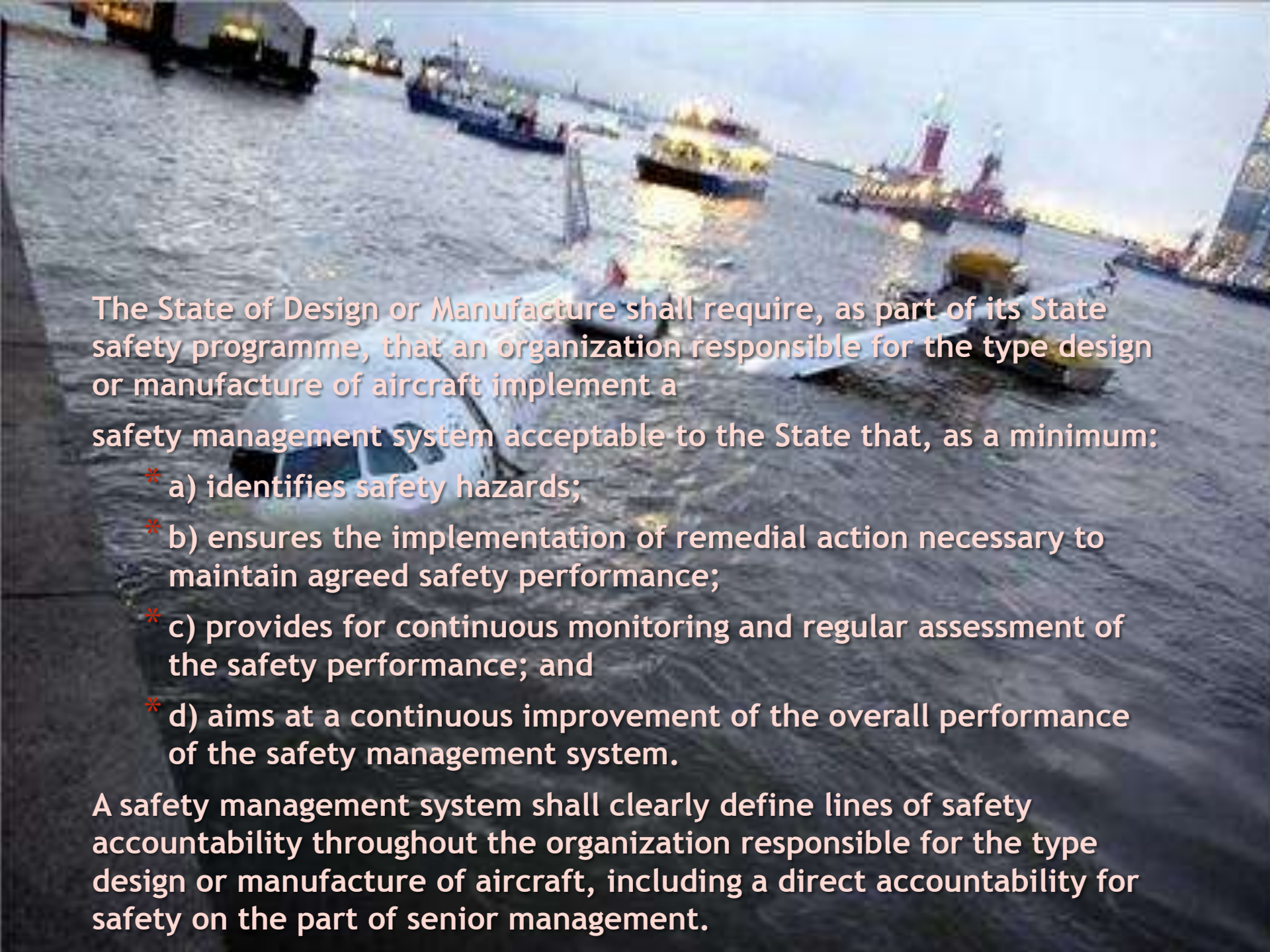
## \* Safety Management: Aircraft Operators' Duties



Safety management System must, at minimum:

- \* a) identify safety hazards;
- \* b) ensure the implementation of remedial action necessary to maintain agreed safety performance;
- \* c) provide for continuous monitoring and regular assessment of the safety performance; and
- \* d) aim at a continuous improvement of the overall performance of the safety management system.

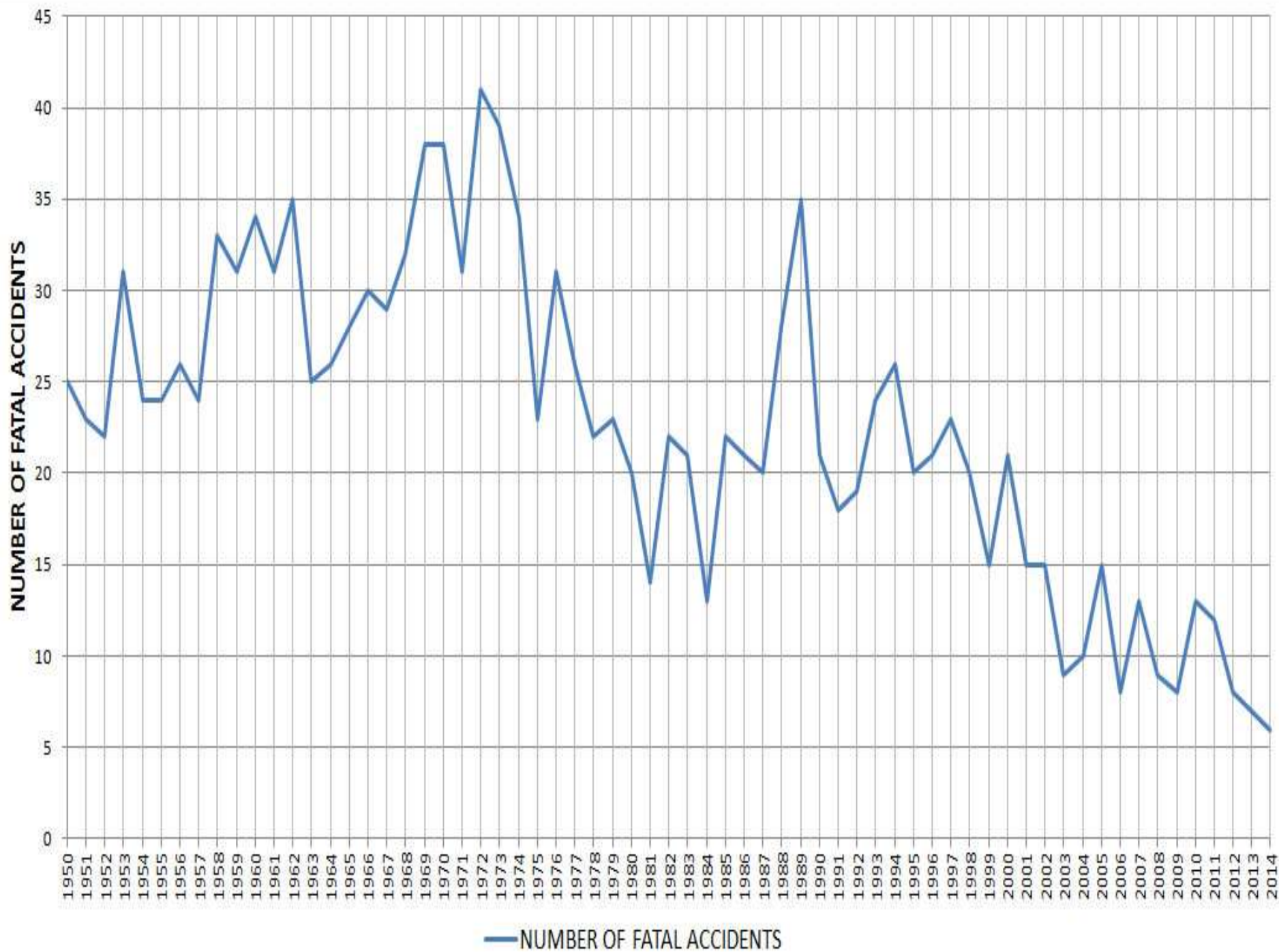
A safety management system shall clearly define lines of safety accountability throughout the operator's organization, including a direct accountability for safety on the part of senior management.

An aerial photograph of an offshore oil rig in the middle of the ocean. Several support vessels, including supply ships and tugboats, are positioned around the rig. The water is dark blue, and the sky is overcast. The rig itself is a complex structure with various platforms and cranes.

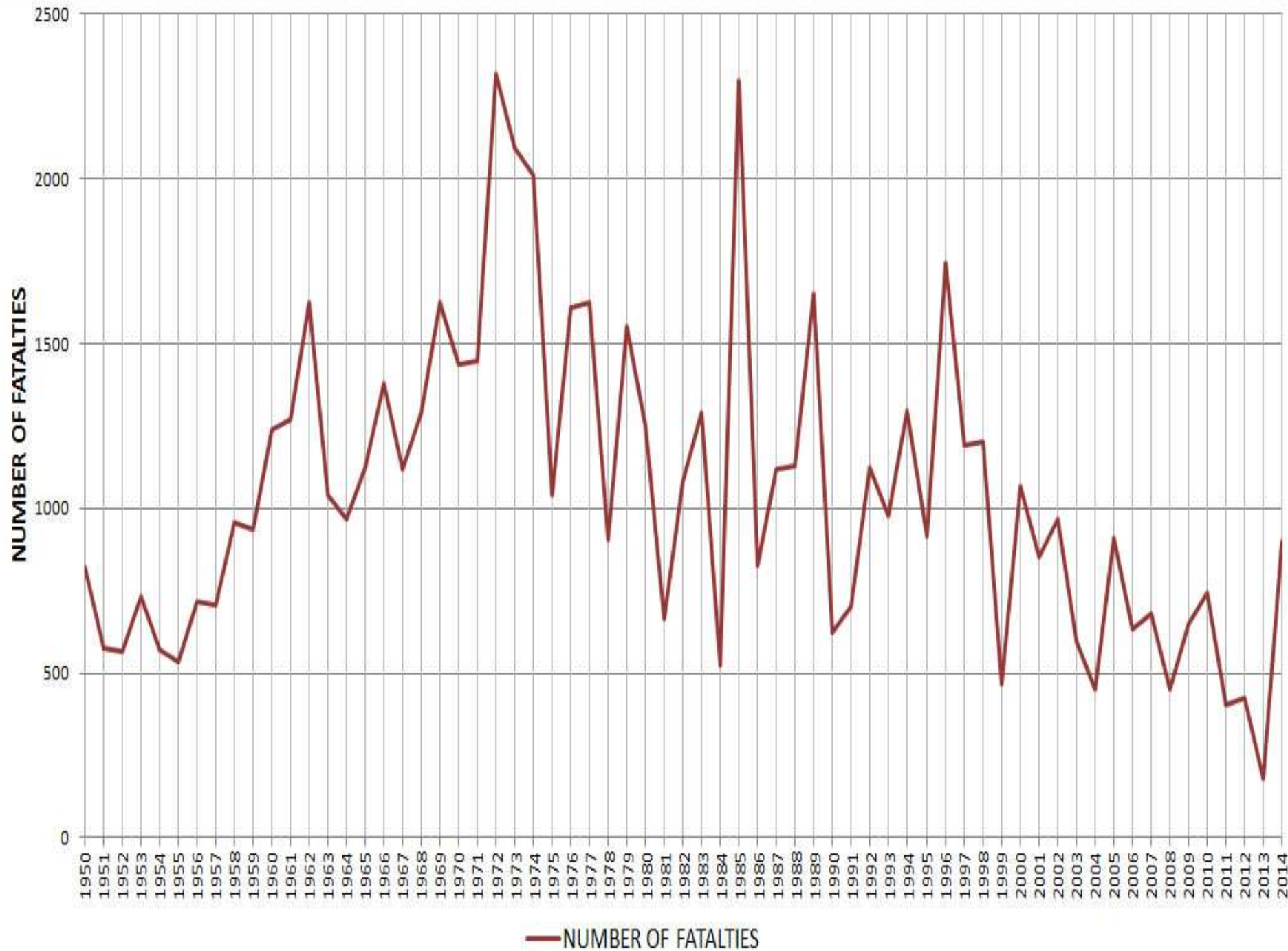
The State of Design or Manufacture shall require, as part of its State safety programme, that an organization responsible for the type design or manufacture of aircraft implement a safety management system acceptable to the State that, as a minimum:

- \* a) identifies safety hazards;
- \* b) ensures the implementation of remedial action necessary to maintain agreed safety performance;
- \* c) provides for continuous monitoring and regular assessment of the safety performance; and
- \* d) aims at a continuous improvement of the overall performance of the safety management system.

A safety management system shall clearly define lines of safety accountability throughout the organization responsible for the type design or manufacture of aircraft, including a direct accountability for safety on the part of senior management.







## 2014 was a year of contrasts: safe but with some tragic events\*

Global jet hull  
loss rate is

**1**

ACCIDENT

**4.4**  
MILLION  
FLIGHTS

IATA member jet hull  
loss rate is

**1**

ACCIDENT

**8.3**  
MILLION  
FLIGHTS

For all aircraft  
types, there were

**12**

FATAL  
ACCIDENTS IN

**38**  
MILLION  
FLIGHTS

In real terms,  
this means

**641**

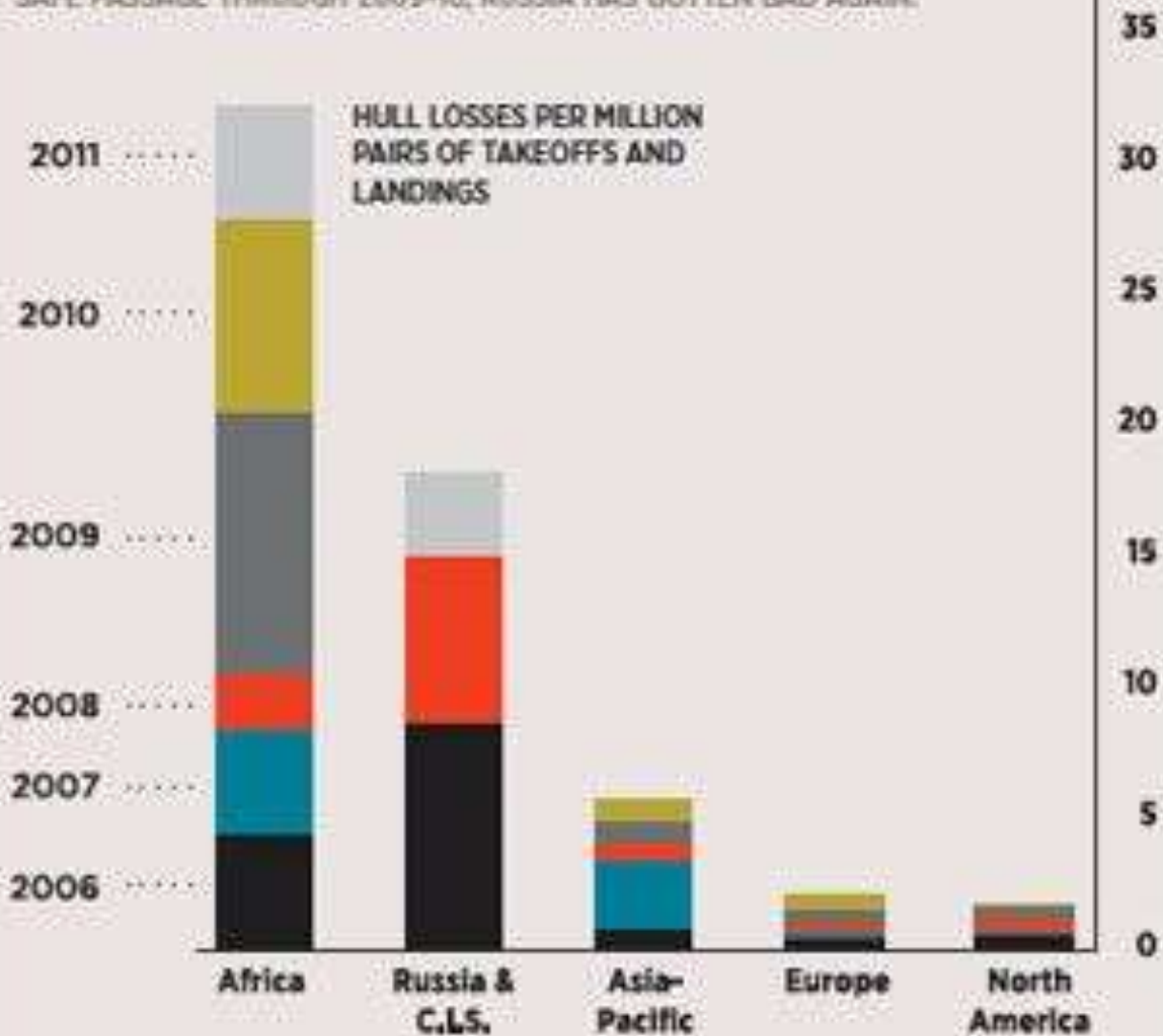
FATALITIES  
IN

**3.3**  
BILLION  
JOURNEYS

*\* Figures do not include MH17, which is not classified as an accident under international safety reporting standards.*

## ACCIDENTS WILL HAPPEN

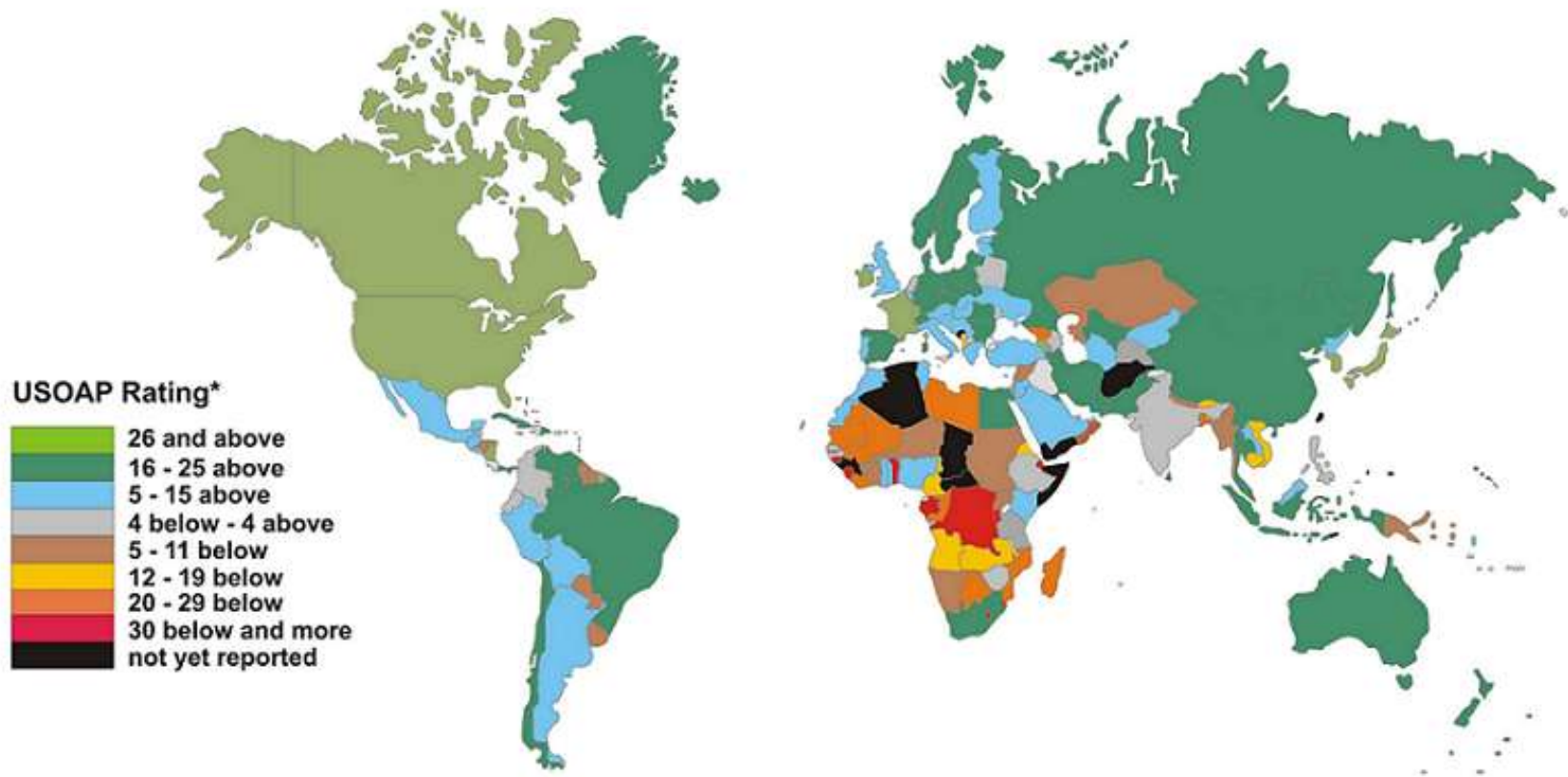
RUSSIA AND SUB-SAHARAN AFRICA TRADE PLACES AS THE WORLD'S MOST DANGEROUS FLIGHT ZONES. AFTER RELATIVELY SAFE PASSAGE THROUGH 2009-10, RUSSIA HAS GOTTEN BAD AGAIN.



SOURCE: AIA



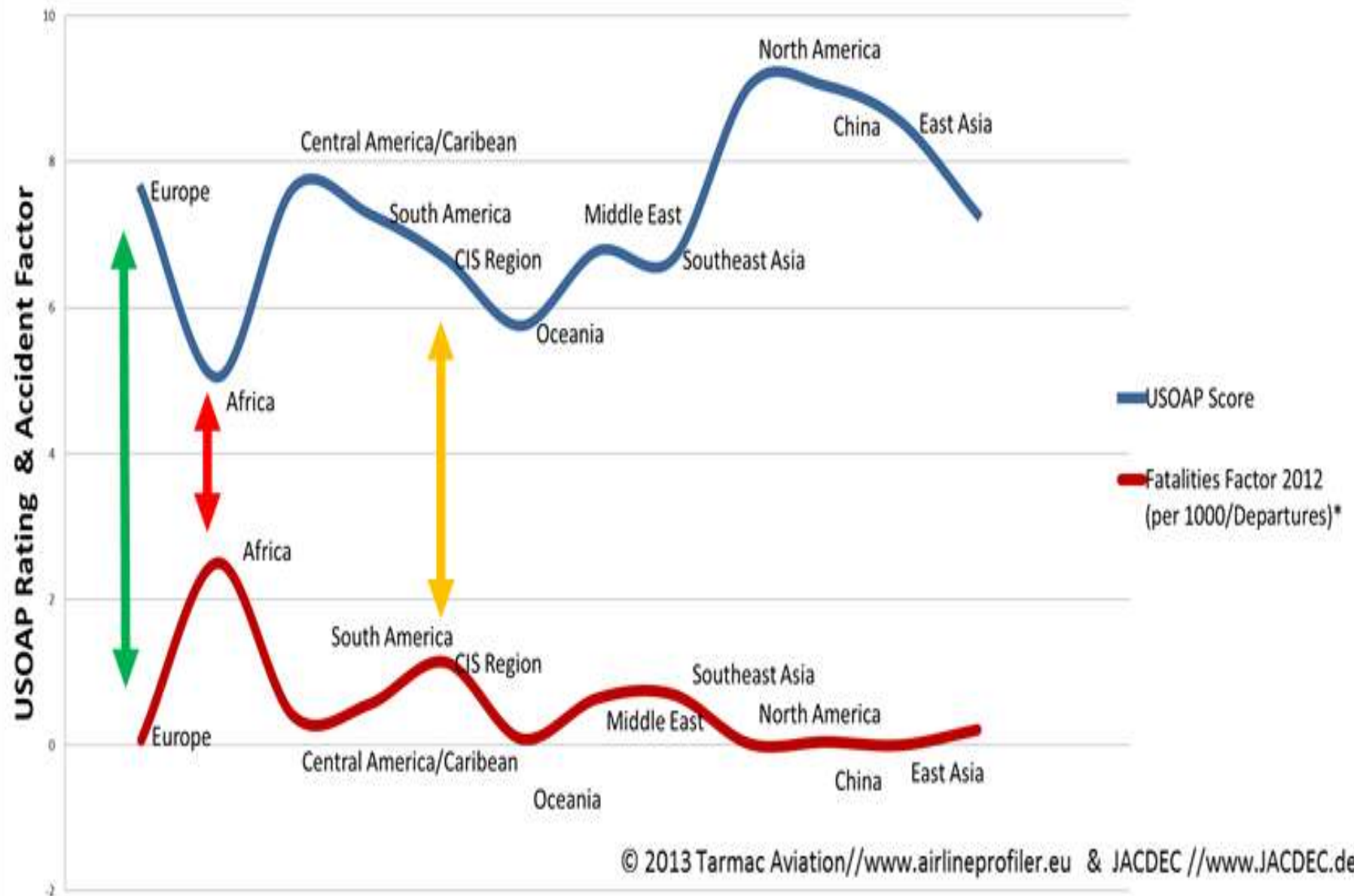
# JACDEC Worldmapping Universal Safety Oversight Audit Programme



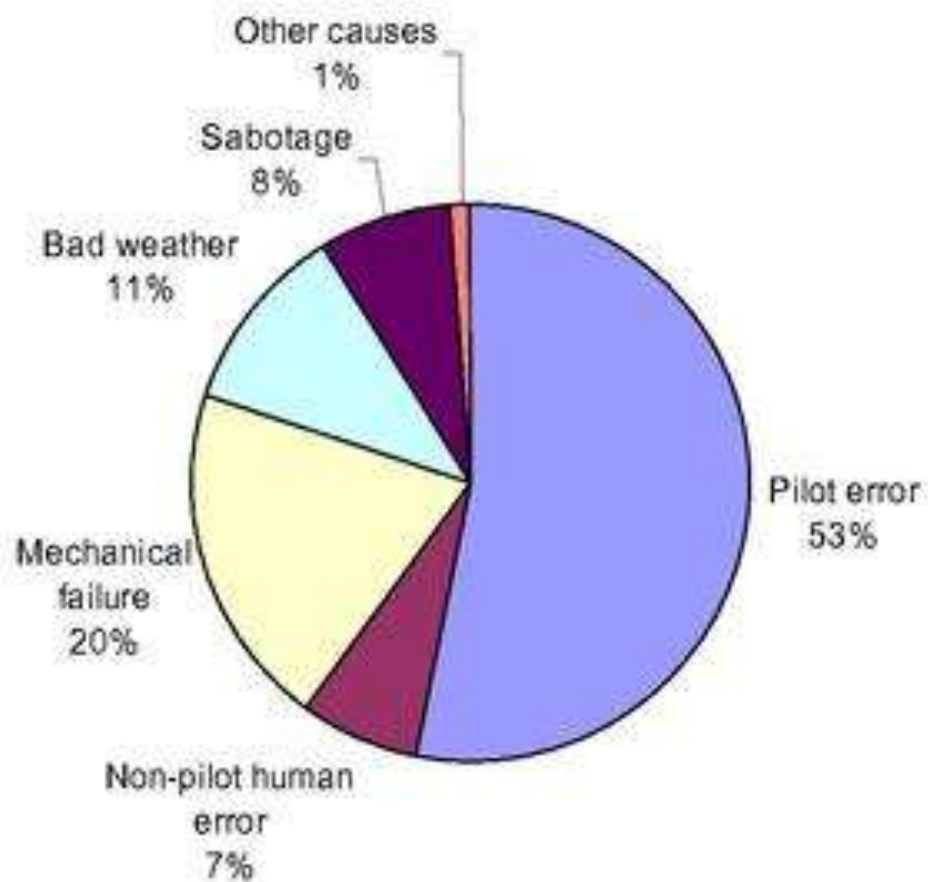
\* = shown is the deviation from the global average safety performance.  
The current world average grading based on the USOAP Comprehensive Systems Approach is 47.

© JACDEC, 2012

Relation USOAP & Accident Rate by Region



## Causes of fatal aviation accidents





# Percentage of accidents/fatalities

