



BAE SYSTEMS



*Airborne Integrated Systems for Safety Improvement,
Flight Hazard Protection and All Weather Operations*

**FLYSAFE
FORUM N° 01
ATM and meteorological
highlights**

27 – 06 - 2006

EUROCONTROL Brussels



ATM Themes In FLYSAFE - 1

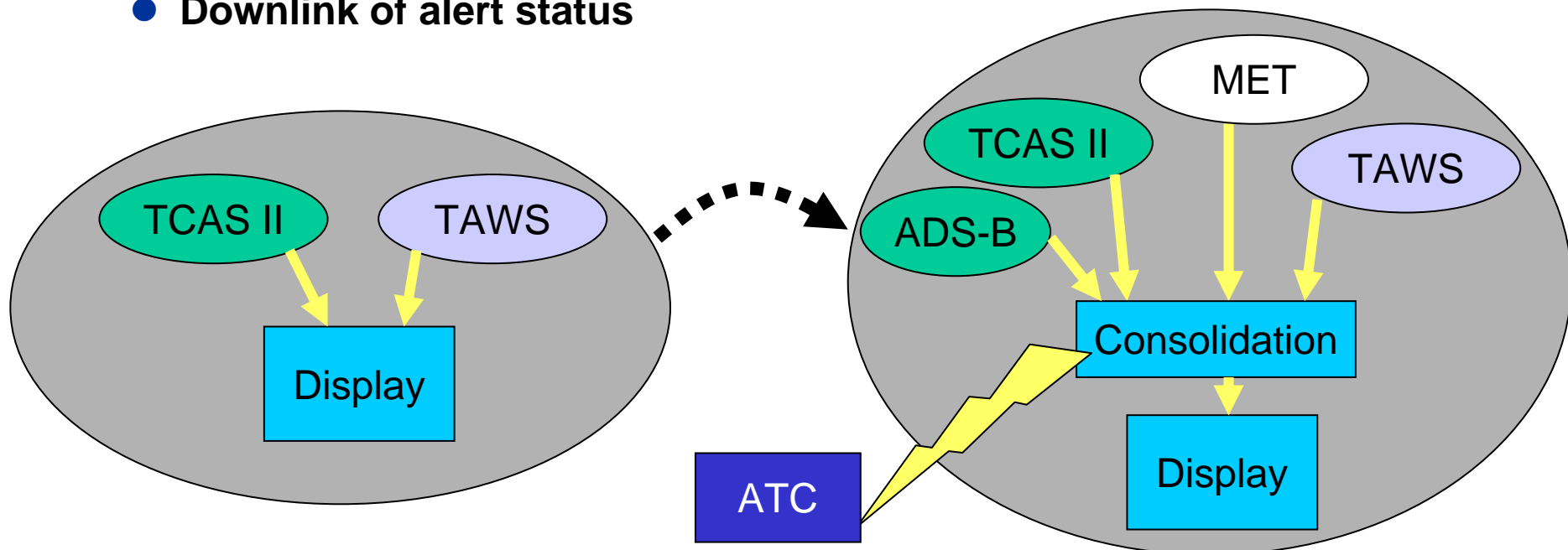
- **Summary**
 - **Integrated Airborne Safety Nets**
 - ◆ TCAS II
 - ◆ TAWS
 - ◆ Met Hazards
 - **Flight Deck Situation Awareness**
 - ◆ Airborne
 - ◆ Surface
 - **Airborne Spacing**
 - ◆ Sequencing and merging
 - **Broadcast Communications**
 - ◆ ADS-B
 - ◆ TIS-B
 - ◆ FIS-B



ATM Themes In FLYSAFE - 2

■ Integrated Airborne Safety Nets

- Currently TCAS II and TAWS act independently
- Emerging technology weather warnings to be added
 - ◆ Detection of windshear, wake vortex, turbulence
- Need an integrated approach to avoid conflicting resolutions
- Incorporation of ADS-B and intent to minimise nuisance alerts
- Downlink of alert status





ATM Themes In FLYSAFE - 3

■ Flight Deck Situation Awareness

● Airborne

- ◆ Enhanced situation awareness to reduce safety net usage
- ◆ Enhanced situation awareness to reduce runway incidents
- ◆ Improved displays reduce confusion
 - Vectors and intent clarify potential conflicts
- ◆ Automated short term conflict detection
 - Resolution before TCAS RA – planned response

● Surface

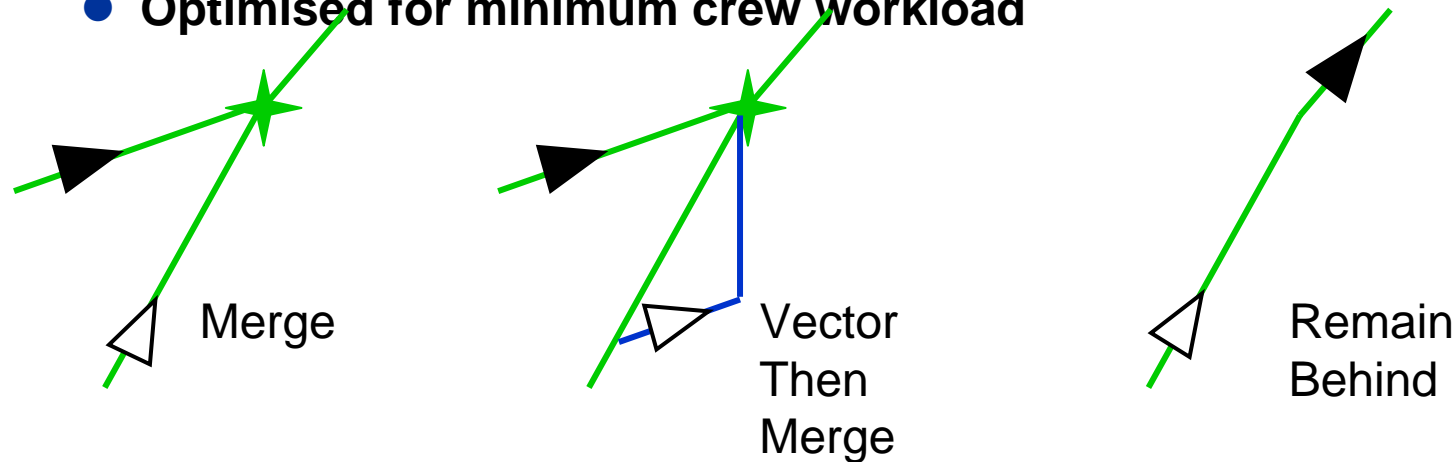
- ◆ Enhanced situation awareness to reduce runway occurrences
 - Runway incursion and runway entry warnings
- ◆ Enhanced situation awareness to reduce taxi occurrences



ATM Themes In FLYSAFE - 4

■ Airborne Spacing

- Sequencing and Merging maintain airspace and runway capacity
- Optimised for minimum crew workload



■ Broadcast Communications

- ADS-B & TIS-B – Fused then correlated with TCAS targets
- FIS-B – General traffic and met situation awareness



*Airborne Integrated Systems for Safety Improvement,
Flight Hazard Protection and All Weather Operations*

Meteorological Highlights

Weather is an aviation efficiency issue !

Weather is a safety issue !

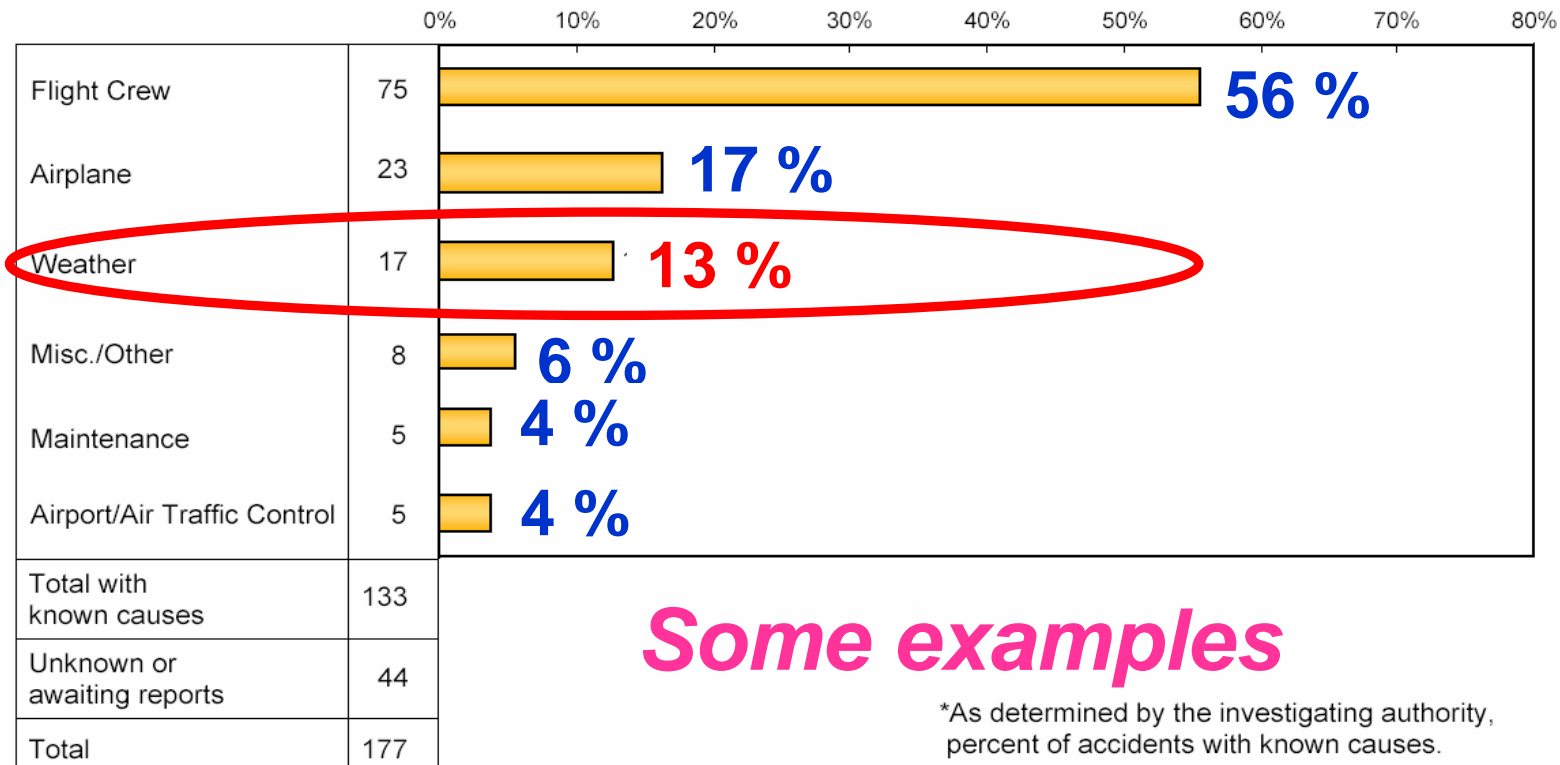


Weather is a safety issue



Accidents by Primary Cause*

Hull Loss Accidents – Worldwide Commercial Jet Fleet – 1995 through 2004



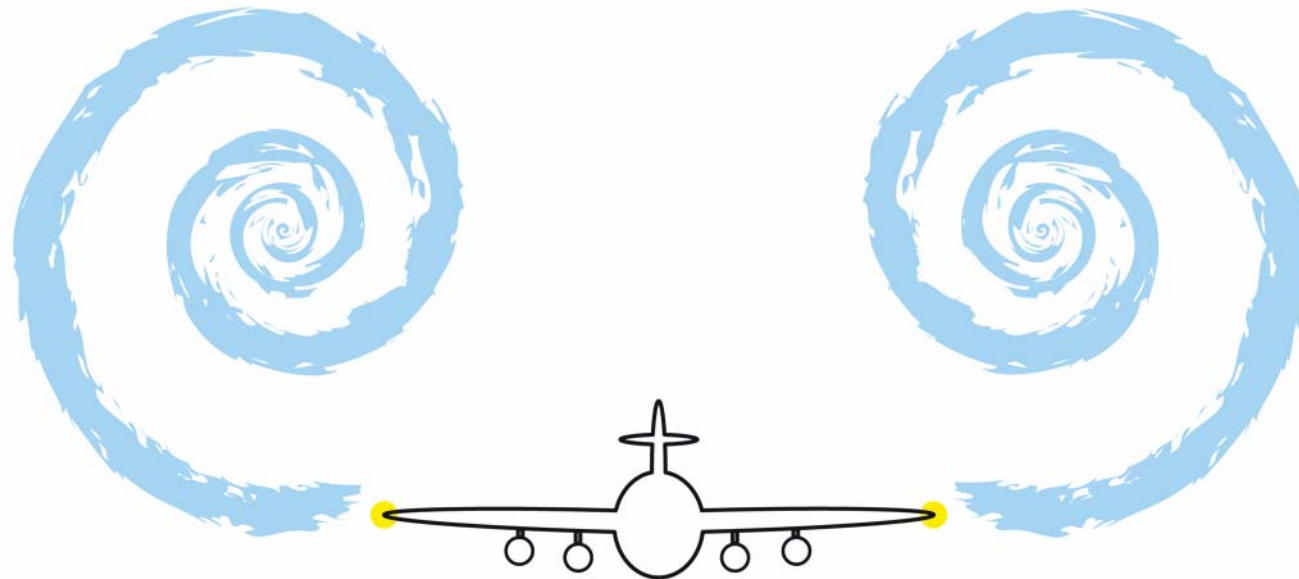
Some examples

*As determined by the investigating authority, percent of accidents with known causes.





Wake Vortices and wake turbulence may be hazardous

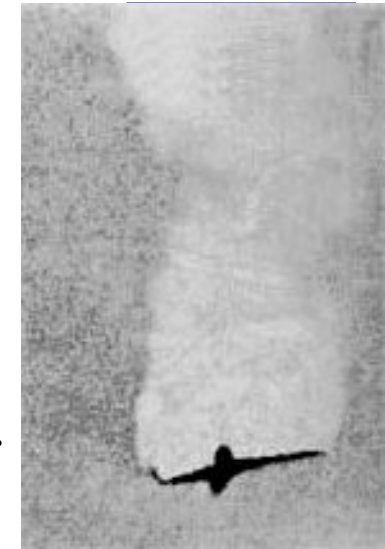


This document is produced under the EC contract AIP4-CT-2005-516167.

It is the property of the FLYSAFE consortium and shall not be distributed or reproduced without the formal approval of the FLYSAFE Steering Committee



CAT is a Safety Issue



A British Overseas Airways Boeing 707 is seen in its last stages of being torn apart by **clear air turbulence** over Mt. Fuji, Japan. The plane flew into a mountain wave after the captain decided to give the passengers a close-up view of Mt. Fuji. All 124 people aboard were killed. (March 3, 1966)

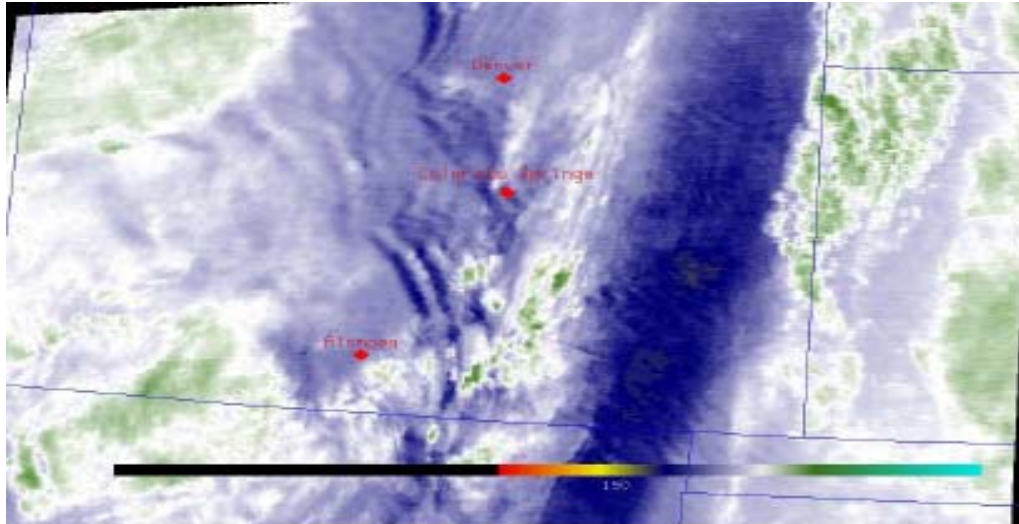
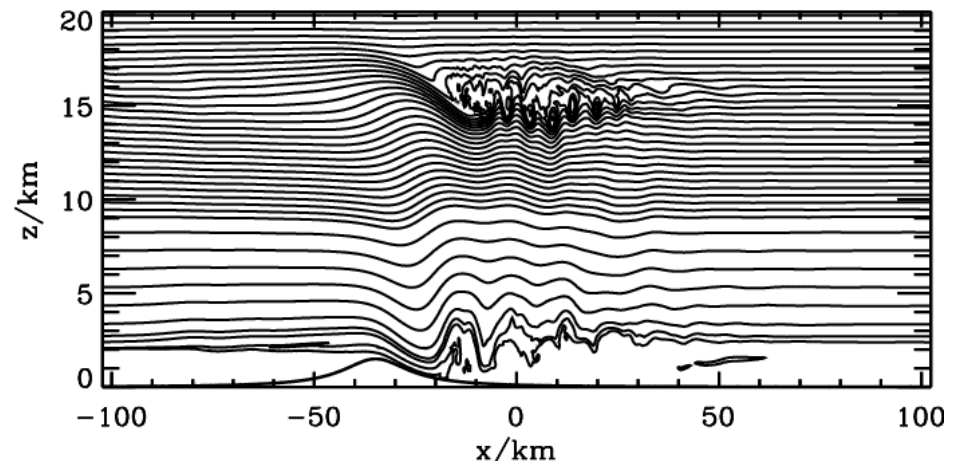
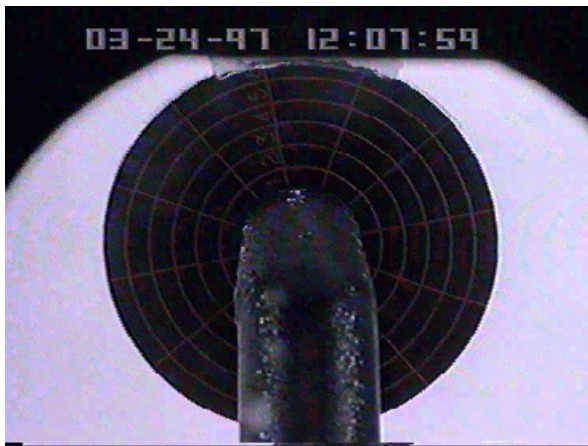


Fig. 1. Water vapor image from MODIS satellite, Feb. 27, 2004 at 0525 UTC. Note the distinct wave pattern northeast of Alamosa, CO.





In-Flight Icing is a Safety Issue

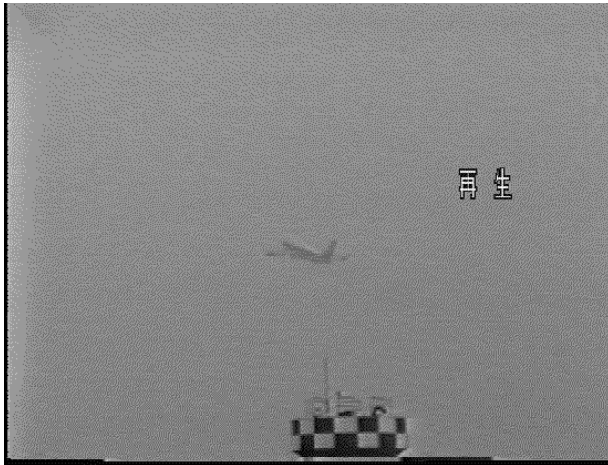




Thunderstorms are a Safety Issue



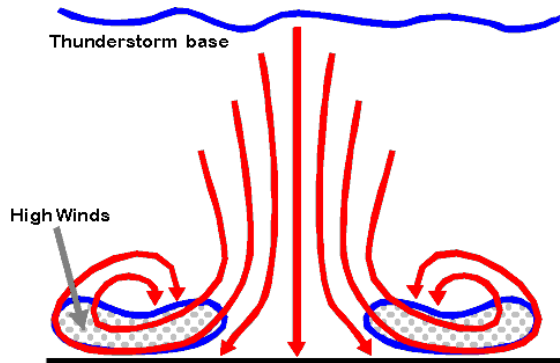
for more than one reason:



- wind shear
- turbulence
- lightning stroke
- hail
- icing
- heavy rain
- CAT

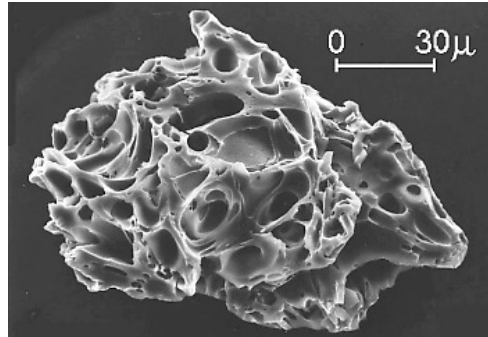


Boeing 737,
Geneva 15 Aug. 2003





Volcanic ash is an atmospheric hazard



**volcanic ash is
abrasive and
corrosive**

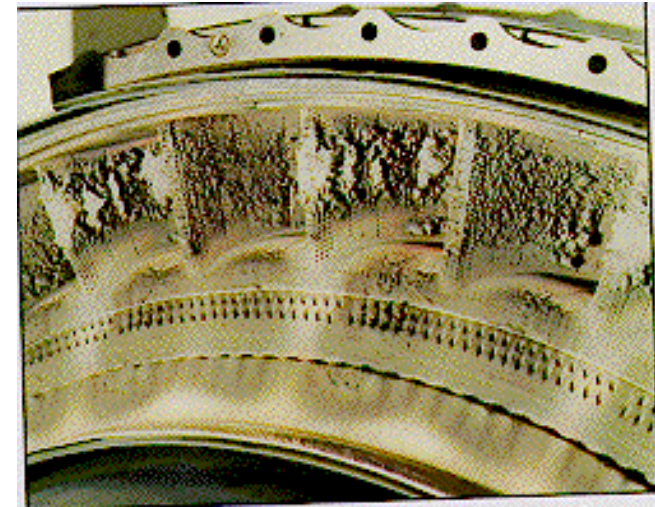
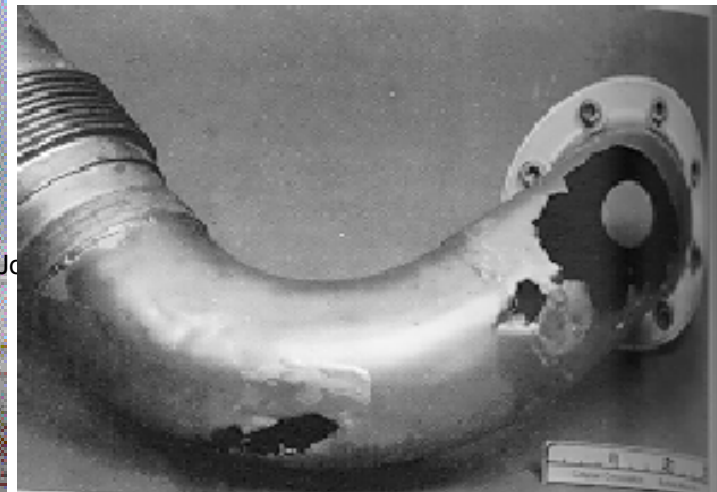


Photo Provided by FAA Aviation Safety Jo



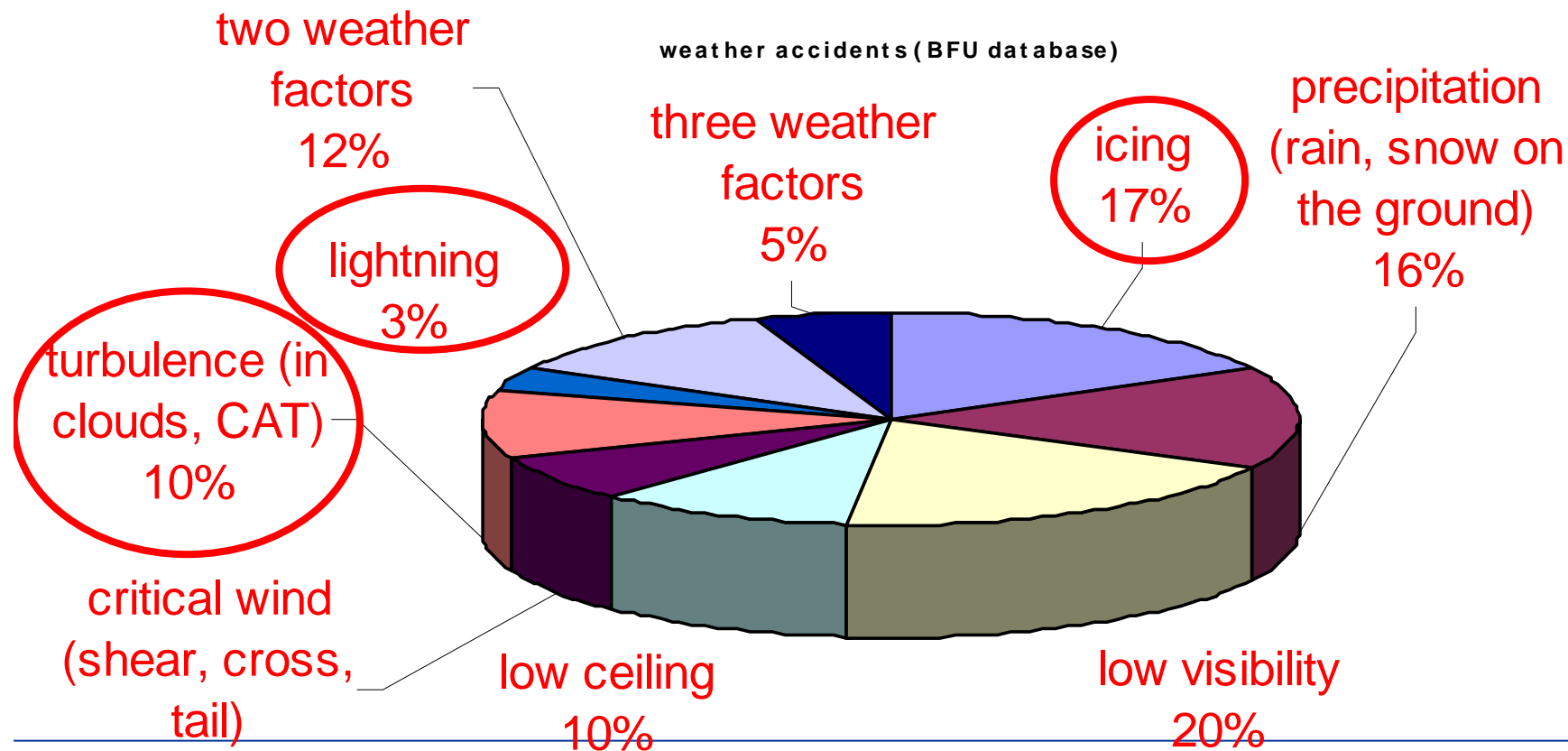


Accidents with weather involved



**German data: 403 accidents and incidents
(>2.0 t, 1980 – 2004)**

=> in 14 % of all cases „weather“ was at least a contributing factor



This document is produced under the EC contract AIP4-CT-2005-516167.



Weather hazards addressed by FLYSAFE



FLYSAFE focuses on relevant hazards:

- **Clear air turbulence**
- **Wake vortices**
- **Thunderstorms**
- **In-flight icing**

**with new developed weather products – the
WIMS.**



Current situation and FLYSAFE improvements



- **Current aviation weather hazard products do not meet the pilots needs. The pilot wants a timeliness and accurate weather information of high spatial resolution and with modern graphics**
- **Within FLYSAFE, therefore, **new** weather hazard products**
WIMS = Weather Information Management Systems
are developed.

<< MET HIGHLIGHT >>



Current situation and FLYSAFE improvements



- **WIMS products are** << MET HIGHLIGHT >>
 - **generated at the ground,**
 - **sent to the aircraft on request**
 - **prior to the flight and during all subsequent flight phases,**
 - **upgraded through merging with on-board data,**
 - **fused with traffic and terrain hazard information, and finally**
 - **displayed to the pilot in an appropriate way.**



Met data in FLYSAFE



- **WIMS data are tailored to the respective aircraft type (eg for icing severity) and for the actual flight path.**

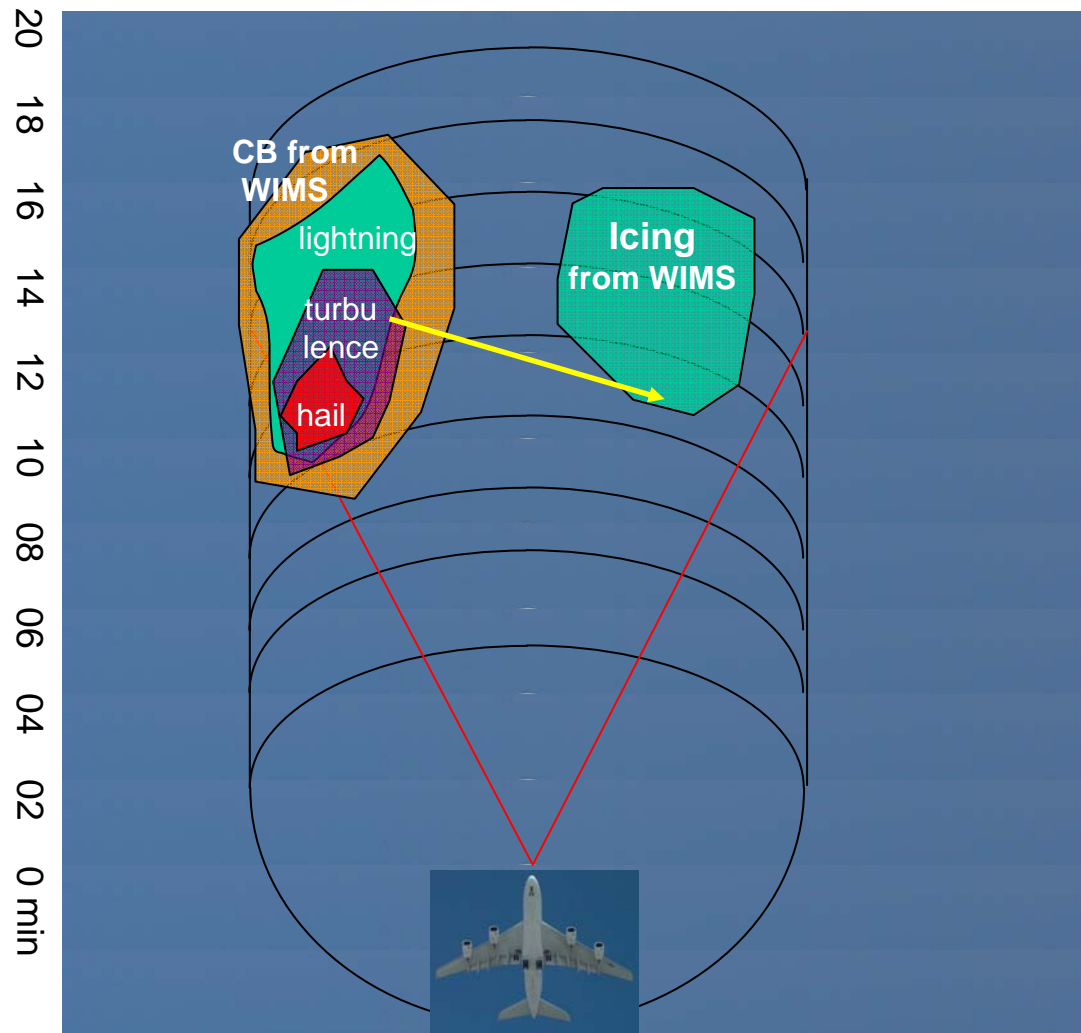
<< MET HIGHLIGHT >>

- **On-board radar data will be fused, for example, with the thunderstorm WIMS data, to provide the best possible picture of the hazard to the pilot.**
- **Other on-board data will be fused, for instant, to improve the WIMS wake vortex product.**

<< MET HIGHLIGHT >>



sketch of pilot display





Met data in FLYSAFE



- In addition, routinely available data will also be provided to the cockpit.

<< MET HIGHLIGHT >>

- The pilot, therefore, has besides the new WIMS weather information also commonly used, surface based and routinely distributed weather products and primary weather data
- These routine data includes eg information on volcanic ash. As it is not feasible to provide all routine data, a prioritisation was done



WIMS data and a prioritised list of routine data



WIMS

1. CB
2. ICE
3. CAT
4. WV

ROUTINE DATA

1. Volcanic Ash info
2. Tropical storm info
3. METARs (and SYNOPs)
4. SIGMETs
5. TAFs/TRENDS
6. SIGWX charts (both from National Met Service or from World Area Forecast Centre)

PRIMARY DATA

7. Atmospheric state parameters
8. Satellite Imagery
9. Lightning detection system outputs
10. Numerical Weather Prediction (NWP) data
11. Radar data



Met data in FLYSAFE



- **Weather hazard data will be provided to the pilot together with traffic and terrain hazards**

<< MET HIGHLIGHT >>



Summary



- **WIMS data represent a new generation of **timeliness, accurate** and **global** weather information provided to the pilot during **all phases of flight.****
- **The provision of WIMS data as part of FLYSAFE is fully compliant with the **ATM 2000+** and **Aeronautical Information Management strategies****



Summary



- **With the FLYSAFE project the met data provision to the aviation community has made a **major step forward** to meet these strategic goals**
- **weather is recognized as an important safety issue**



Summary



The provision of met data to ATM is a logical next step to make up-to-date modern met data available to all partners within the aviation community for collaborative decision making.

FLYSAFE offers an unique possibility to mitigate the impact of weather on safety and efficiency of aviation operations.



Bottom line:

As we cannot change the weather, we have to live with it!

Develop for each weather hazard a specific product !

Monitor, warn, and avoid !



THANK YOU FOR YOUR ATTENTION



- **WIMS data represent a new generation of timeliness, accurate and global weather information provided to the pilot during all phases of flight.**
- **The provision of WIMS data as part of FLYSAFE is fully compliant with the ATM 2000+ and Aeronautical Information Management strategies**
- **With the FLYSAFE project the met data provision to the aviation community has made a major step forward to meet these strategic goals**
- **The provision of met data to ATM is a logical next step to make up-to-date modern met data available to all partners within the aviation community for collaborative decision making.**
- **FLYSAFE offers an unique possibility to mitigate the impact of weather on safety and efficiency of aviation operations.**
- **As we cannot change the weather we have to live with it. The bottom line of our approach is **monitoring, warning and avoiding weather hazards** .**



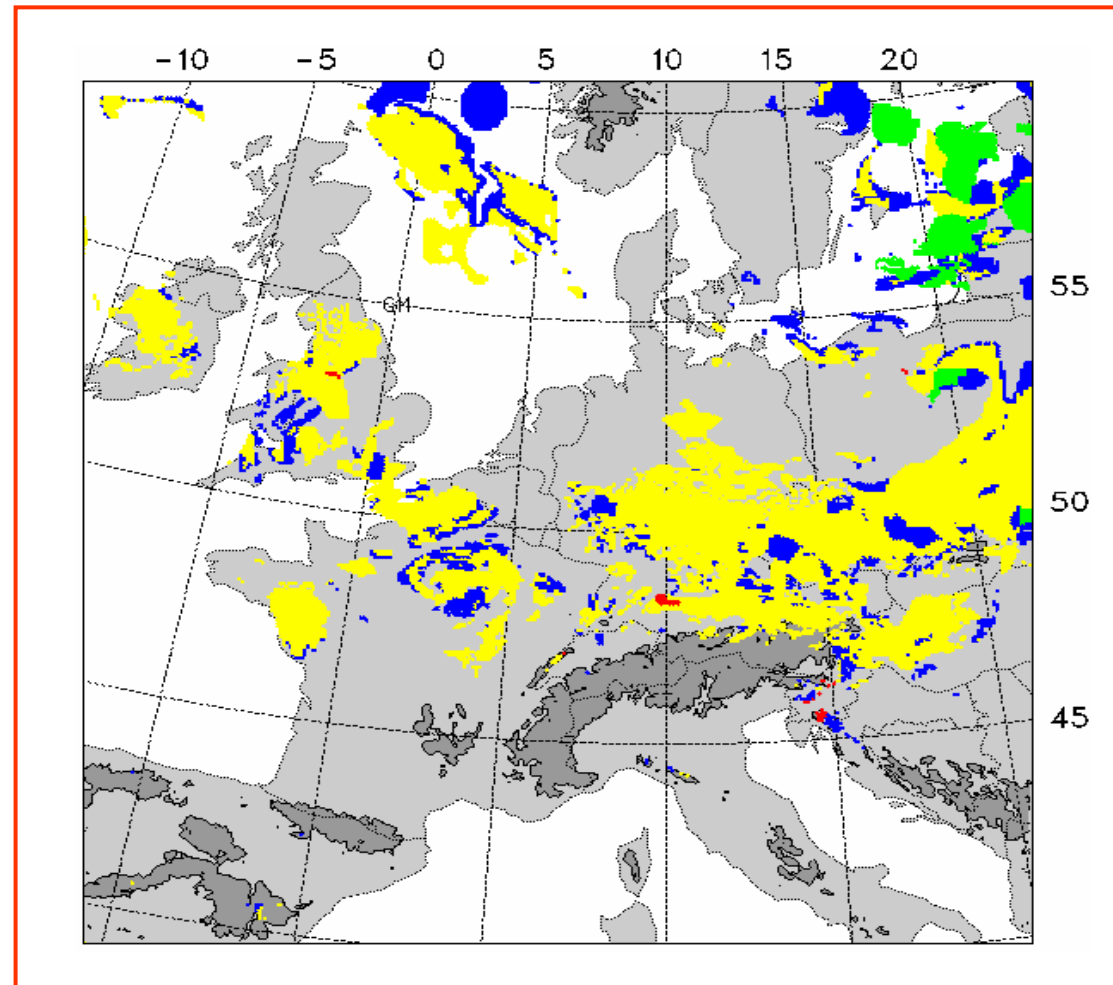
Example of WIMS ice output



Four different icing types:

freezing convective
stratiform general

- global coverage
- high level of details over Europe





Weather hazards addressed by FLYSAFE



FLYSAFE focuses on relevant hazards:

- **Clear air turbulence**
- **Wake vortices**
- **Thunderstorms**
- **In-flight icing**

with new developed weather products – the WIMS.

FLYSAFE also uses existing weather products; eg for

- **Volcanic ash**
- **Significant weather**
- **Poor visibility**
- **Tropical cyclones**
- **.....**



Current use of Met data by ATM



- **There are no international standards for provision of Met data to ATM apart from TAFs, METARs**
- **ATM Centres vary widely in what Met data they have available and use**
- **In North West Europe (e.g. UK) biggest problem is fog and ATM centres will have access to non-standard information on this hazard**
- **In South East Europe (e.g. Mediterranean) biggest problem is thunderstorms and ATM centres may have access to detailed information , depending on local arrangements**
- **WIMS data will be also made available to ATM**

T.1

The provision hazard and aircraft specific WIMS data to the pilot during all phases of a flight is thus fully in line with the strategic objective of the Aeronautical Information Management strategy and the ATM 2000+ strategies.

With the FLYSAFE project the met data provision to the aviation community has made a major step forward to meet these strategic goals. The provision of WIMS data to ATM is a logical next step to make up-to-date modern met data available to all aviation partners for collaborative decision making.

Once again with FLYSAFE is on the way to meet the future requirements for timeliness, accurate and cost-effective met data provision.

As we cannot change the weather we have to live with it. Thus our bottom line is: hazard monitoring.

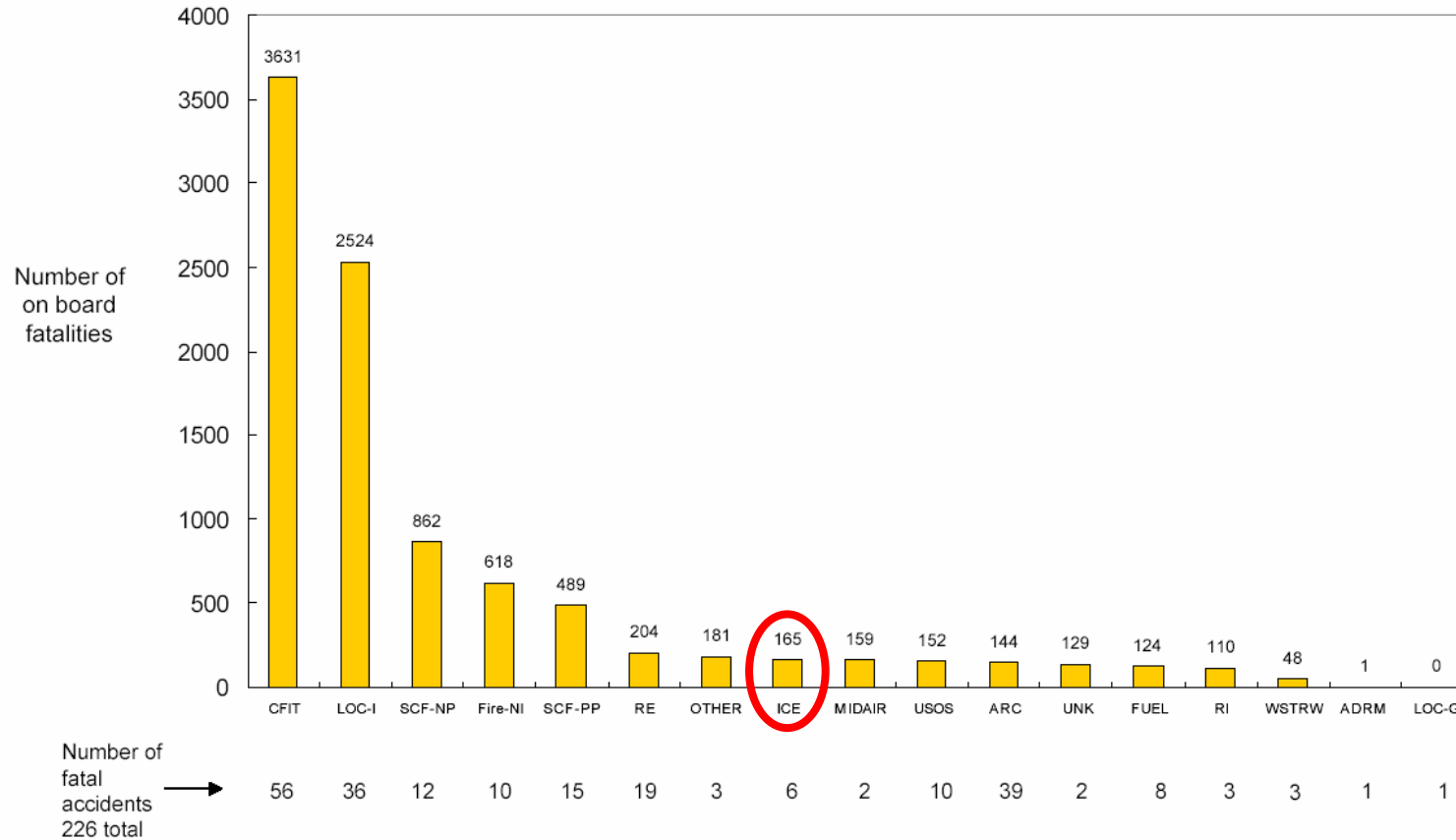
Hauf; 24.06.2006



Weather as a safety issue



Fatalities by CAST/ICAO Taxonomy Accident Category* Fatal Accidents – Worldwide Commercial Jet Fleet – 1987 Through 2004



* See page 19 for the CAST/ICAO category definitions





Need to prioritise routine data



- **There is a large number of different types of routine meteorological data currently used by aviation**
- **Different formats are involved**
- **Data will need to be processed through a large number of computer systems to be transmitted from National Meteorological Services to the flight deck**
- **We have therefore decided to prioritise the data types and give relatively high priority to items high in list on following page**



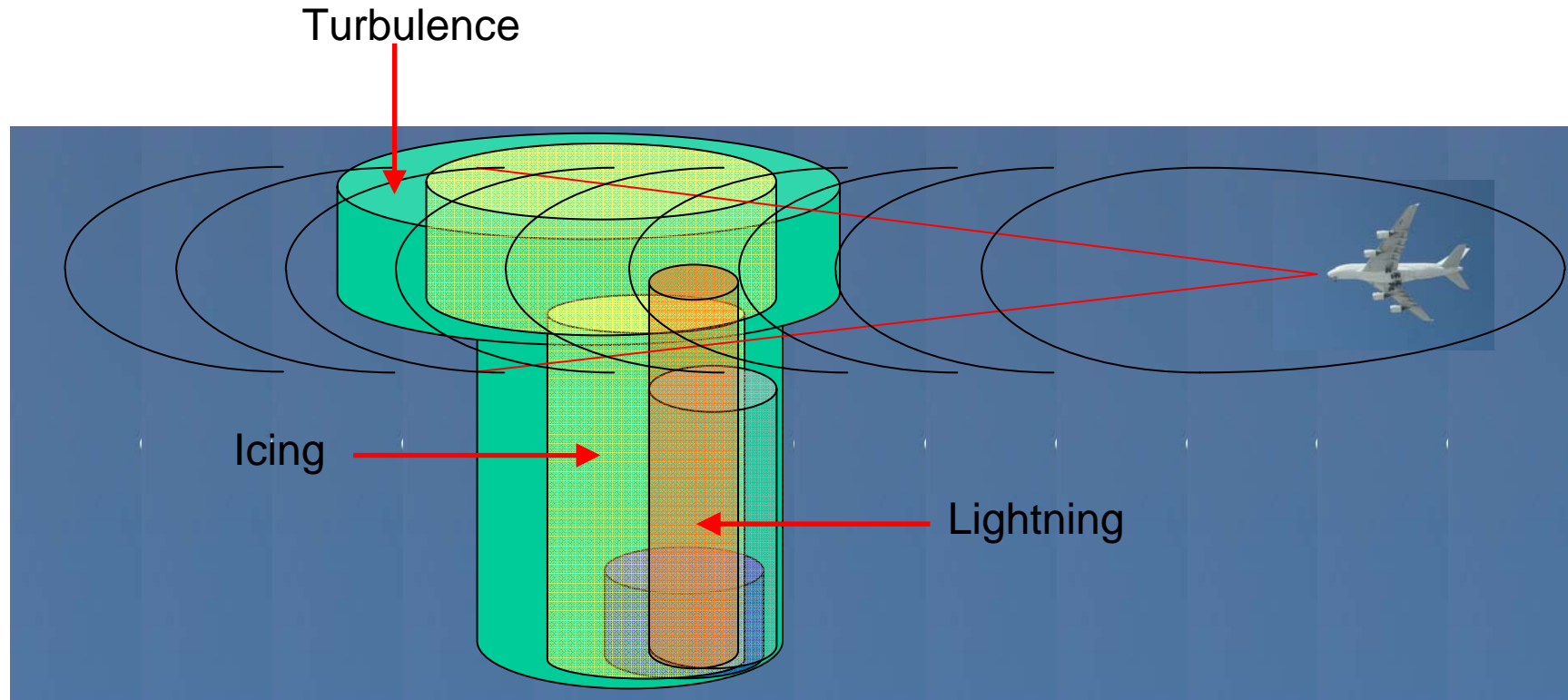
Weather data use by ATC in Holland



- **Air Navigation Service Providers have a kind of weather office**
- **A closed circuit information system provides both current and predicted weather**
- **Both weather radar data and runway parameters (wind, temperature, humidity, RVR) are available**
- **Different use of data is made by ground control/tower control/approach control/en-route control depending on their requirements**



Possible output from thunderstorm WIMS showing turbulence and lightning hazards



Based on this 3-D data, suitable cockpit presentations will be developed.



... and a conceptual model of a thunderstorm weather object within CB WIMS (WP225)

