The bridge from meteorological research to improved safety of air transport

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6 to 10 November 2017, Météo-France, Toulouse
Global view on MET
Cost of aeronautical meteorological services are 0.5% of the total air transport cost.

Total ANS Cost, $49,985,000,000

Total MET Cost, $3,748,875,000

Source: IATA end-year report 2016 & Eurocontrol 2004
Weather a major problem in US, a smaller problem in Europe measured in delay

- In the US National Airspace System (NAS), 69% of delays are caused by weather according to the FAA
  - Impact mainly caused by few East Coast airports: EWR, LGA and JFK
- In Europe, weather is a large cause of delay, but the airspace is much less congested and risks can be mitigated
  - Major impact at LHR with wind and visibility
- European weather conditions are generally worse and more flights are operated in Instrument Meteorological Conditions (IMC) than in the US
Global research situation

- Research and development of meteorological services to aviation is not globally evenly distributed, operating under a unified strategy or adequately funded.
- A global strategy and roadmap to encompass meteorological service provision can be only founded on the defined needs and requirements of the main air transport industries.
- A global vision needs to include a position on what the most important research questions are and where the integration of meteorological information to decision support systems is most needed.
- Transparency into planned and ongoing development activities with open access publishing standards of research results of meteorological applications will speed up development significantly.
Organizing research activities
Increasing model resolution is key to improving terminal area wind information to users.

- End user needs, systems and procedures analysed
- Grid spacing and model timestep in numerical model decreased
- Model processes adapted for finer resolution
- Model output verified, validated and compared with earlier model results
- More accurate temporal awareness of crosswind conditions
- Integrated weather information into decision support systems
- Research to operations project based on end user needs developed and implemented
- Results documented
- Enhanced planning of runway capacity restrictions
- Later start and earlier lifting of runway capacity restrictions
- Reduced holdover time, fuel burn, arrival & departure delay
Improving Eddy Dissipation Rate (EDR) observations and forecast algorithms leads to safer flights.
Convective weather in-flight situational awareness leading to optimal route and fuel burn
Improved de- and anti-icing forecasting reduces departure delay at airport

- End user needs, systems and procedures analysed
- Enhanced measurements of snowfall rate and atmospheric variables at airport carried out
- Liquid-equivalent snowfall rate representation in numerical models improved
- Validation and verification of LWE forecasts completed and results documented
- Forecast method tailored for local airport conditions and climatology
- Historical icing incident archives, de-icing need and anti-icing fluid use statistics reviewed
- Information integrated into end user systems and processes
- Use and timing of de-icing and anti-icing operations improved
- Use of anti-icing fluid reduced, de-icing operations shortened, departure delay reduced and risk of icing reduced
Improvement in weather services for RPAS operators leads to increase safety in drone flight.

- Improved situational awareness of operators
- Reduced operations in hazardous conditions
- Reduced loss of aircraft and serious safety incidents related to weather

Aircraft manufacturers' published performance criteria reviewed

Legislation and local airspace rules reviewed

Location and aircraft type specific weather constraints agreed with local operators and regulators

Information integrated into end user decision support systems and existing weather briefing systems

Weather constraints translated into no-fly zones and formatted into SWIM-compliant XML/GML

Information integrated into end user decision support systems and existing weather briefing systems
Weather in ATM decision support can result in reduced en-route and weather delay.

| End user needs, systems and procedures analysed | Validation and verification of the impact and quality of meteorological information | Operational validation into ANSP systems |
| Assessment of local weather induced airspace constraints and ATM workload | Weather objects and parameters disseminated in SWIM-compliant format | Improved awareness on the evolution of weather constraints and associated impact on airspace |
| Analysis of adverse weather mitigation strategies as part of the CDM process | Development and tailoring of meteorological information for ATM needs | Reduced weather-induced en-route and airport delays |
Forecasting HIWC/HAIC at high altitudes enhances aviation safety.

- Global end user needs established with engine and aircraft manufacturers
- International agreement on the content of the service
- Research and development of operational detection and forecast methods
- Continuous operational verification of service
- Deployment of operational service
- Verification and operational validation of the solution
- Continuous re-evaluation of operational criteria with industry
- Reduced in-flight engine malfunctions caused by ingestion of ice crystals
- Improved aviation safety
Proposed steps to improve global meteorological service provision for air transport

- Dialogue with airlines, ATM and regulators on key improvements
- Global strategy on MET service upgrades
- Agreement on cost sharing for development and maintenance of enhanced meteorological services
- Regular and systematic performance review of global MET service provision
- Exchange of knowledge, open source development and publishing standards established
- Necessary agreements at regional levels to ensure implementation and monitoring mechanisms
- Cost harmonisation for MET services and infrastructure costs
- Establishment of regional specialised centers to support local MWOs
- Empower local expertise by providing access to state-of-the-art meteorological guidance and software
Conclusions

• Research and development of meteorological services, products and information to support air transport need to be user-driven and tailored to specific needs and constraints
• Meteorological research is only one important component of such a project
• Projects should be motivated by clear improvements in aviation safety and capacity of the airspace and benefits quantified whenever possible