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Climate change will have an impact on aviation and understanding new weather patterns will be vital to efficient operations.

A combination of meteorological science and operational expertise is needed to better understand how air traffic management (ATM) will be affected by the ongoing changes in weather patterns.

Studies show that climate change is having a number of effects. here are increases in turbulence and storm activity, shifts in the jet streams towards the poles and a higher ice content at altitude.

As temperatures rise there will be more air quality issues, reducing range and payload capabilities. Slow-moving convective storms and lightning strikes will force more and longer airport shutdowns while higher surface temperatures will affect take-off performance.

Dr. Herbert Puempel at the World Meteorological Organization (WMO) Commission for Aeronautical Meteorology and Co-Chair, ET-Aviation, Science and Climate notes that there are also highly regionalised changes. A Russian Federation study shows large differences in temperature changes in its regions, for example, and the Alps and Arctic are also strongly affected.

Furthermore, longer-term projections about the effects of climate change may actually happen sooner than expected. Puempel believes that the predicted state of the weather in 2100 – complete with the concerns mentioned above – may occur temporarily and regionally any time soon.

Indeed, Wolfgang Bretl, Head of Munich area control centre (ACC), advises that an Alpine Weather Workshop has been set up

to monitor the weather situation in the Alpine area. The ACCs at Vienna, Padova, Zurich, Karlsruhe and Munich are involved with the aim of enhancing coordination and communication processes between ACCs during extreme weather conditions.

Responding to change

In Europe, weather-related delays have increased for five consecutive years. In the FABEC airspace block in Central Europe – consisting of the ANSPs of Belgium, France, Germany, Luxembourg, the Netherlands and Switzerland – adverse weather is the second most frequent cause of delays after capacity constraints. Local thunderstorms have turned especially severe in spring and summer.

FABEC airspace covers 1.7 million km² and handles about 5.5 million flights per year – 55% of European air traffic – so any service disruption and lost airspace capacity is felt acutely across the continent.

Two new initiatives are leading FABEC's response. First, new procedures are in place for aircraft re-routings based on ad-hoc flight plans to avoid local thunderstorms. A flight from Munich to Madrid, for example, might use a longer routing via Italy and the Mediterranean Sea instead of a shorter flight via France.

Second, FABEC is working with the MET Alliance, a consortium of leading European meteorological service providers, to investigate the impact of adverse weather conditions on air traffic management.

The MET Alliance is still in its formative stages and further analyses on the impact of weather need to be done before any results are properly established.

The MET Alliance is looking into such topics as the development of thunderstorms in recent history, the evolution of the jet stream over Central Europe, changes to icing altitudes and the intensity and the vertical and lateral evolution of turbulence.

MET Alliance members are being asked if specific and concrete changes have been observed over the last three to five years.

Energy increase

Alexandre Allard, Senior Advisor Meteorology at Belgocontrol, a member of the MET Alliance, says that because weather patterns are complex, changing and localised, only general consequences of global warming can be identified. "This means that the impact of global warming on a regional scale can hardly be forecast and that one has to be very cautious when trying to draw conclusions from the few quantitative studies available."

What is known is that an increase in the mean temperature of the atmosphere results in an increase of releasable energy, heat and energy being related. Allard explains that means weather extremes will become more likely and/or more severe. Thunderstorms will be fiercer, for example.

And because global warming will primarily concern higher latitudes, the temperature difference between the tropical and polar zones will be reduced. A possible consequence of this is a weakening of the jet stream, causing weather to be stuck in place. So that thunderstorm hanging over the airport may last a lot longer.

Pilot information

For air traffic management, it is not just about predicting changes in weather patterns more accurately. It will be just as vital to get detailed information to pilots en-route to mitigate weather-induced operational issues.

MET Alliance

MET Alliance was formed by:

- Austro Control
- Belgocontrol
- Deutscher Wetterdienst (Germany)
- The Royal Netherlands Meteorological Institute
- Met Eireann (Ireland)
- Météo France
- MeteoLux (Luxembourg)
- MeteoSwiss

Improvements in on-board weather radars will be vital. These are a primary source of real-time information about precipitation zones and convective activity, including related turbulence and icing phenomena and the presence of hail or wind shear.

"Development continues to improve the capabilities of these radars, which could be ideally complemented by other on-board systems for the detection of lightning and so forth," Allard says.

Research is also ongoing into improving the way the latest available meteorological information is transmitted to the cockpit. "Traditional channels of communication like ATIS/VOLMET (Automatic Terminal Information Service/meteorological information for aircraft in flight) should be complemented by new graphical, impact-oriented and easy-to-use products via an electronic flight-bag," Allard suggests.

"Special attention should also be paid to the training of pilots in the field of aeronautical meteorology and the use of on-board weather radar to ensure that the additional weather information is correctly interpreted," he adds.

Climate change will affect aviation. Understanding the new weather patterns will be an important step towards developing solid mitigation measures and improving operational efficiency. ➤

