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#81

ADAPTING TO CLIMATE CHANGE: building a resilient future for aviation

Contents #81

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Foreword

PATRICIA REVERDY

Executive Secretary of ECAC

Welcome to this spring edition of ECAC News, dedicated to exploring the emerging and critical issue of climate adaptation in civil aviation.

Climate adaptation is a genuinely cross-cutting discipline. While mitigating emissions clearly falls within the domain of environmental protection, adaptation addresses those lasting impacts that we are unable to avoid through our environmental activities. This will affect safety, resilience, economic efficiency, social aspects, and potentially many other domains of aviation.

The scientific consensus is that such changes are inevitable, even if our achievements in the environment domain are as good as they can possibly be. The uncertainty lies around the severity of the changes, and the extent to which these effects have already begun. Extreme weather events, along with game-changing phenomena that take effect over many decades, will need to be considered and their possible impacts assessed across all parts of the aviation ecosystem.

Much of our work in this developing field is at quite an early stage. So, in this edition, we look most closely at aspects such as risk identification and assessment. Through examining diverse perspectives, we see how various actors are taking steps to understand the consequences of climate change for aviation and the adaptations we might need to put in place as a result.

We explore the approaches taken by actors at a range of levels: from States developing policy frameworks to develop responses, to individual entities researching impacts and taking action to improve their resilience.

There is still much to do, even to establish the essentials of the way forward in dealing with the question of climate adaptation. This edition invites you to explore the pioneering work that is being undertaken by so many different stakeholders on this subject as we confront one of the most important challenges facing aviation in the decades ahead.

We extend our warm gratitude to all contributors for sharing their expertise and insights, making this edition possible. Your invaluable contributions shape the dialogue and drive progress in this crucial area. ●

> “There is still much to do, even to establish the essentials of the way forward in dealing with the question of climate adaptation.”

Understanding climate change adaptation

Towards a resilient future in civil aviation: the case for urgent action on climate change adaptation

Discussions of climate action in the aviation sector typically focus on mitigation, that is, reducing greenhouse gas emissions. Climate change adaptation – the other half of the climate action equation – has so far received less attention. Recent incidents make clear, however, that the industry is also vulnerable to the impacts of climate change. From flight delays and cancellations due to wildfire smoke, flooding, or even melting tarmacs, to increasing turbulence due to warmer air, the case for investing in adaptation measures in aviation is undeniable.

Understanding adaptation to climate change

The Intergovernmental Panel on Climate Change (IPCC), the United Nations body charged with assessing climate change-related science, defines adaptation in human systems as "the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities." Adaptation to climate change takes place in anticipation of or in response to a wide range of climate change-induced hazards, ranging from rapid-onset events such as floods or fires to hazards that manifest over a longer time horizon, such as rising temperatures or seas. It can be incremental or transformative, depending on the degree to which adaptation measures effect changes in the fundamental attributes of a given social-ecological system.

The process of undertaking planned or anticipatory adaptation to climate change is typically divided into several broad steps. First, assessments of risks and vulnerabilities are conducted to understand how the climate is changing and what risks are posed to natural and human systems as a result. This step is grounded in scientific assessments and systematic observations.

Second, adaptation plans and strategies are developed in response to the findings of the risk and vulnerability assessments. Such plans and strategies include tangible adaptation measures that can be undertaken to reduce climate change-related risks, as well as details such as timelines for implementing these measures, officers or authorities responsible for leading the implementation, expected results, indicators of success, and sources of finance and investment plans.

On the basis of these plans and strategies, the third step is implementing the adaptation measures identified.

Finally, monitoring and evaluation of these measures help assess progress made and effectiveness of measures implemented, and facilitate learning that can improve future adaptation efforts.

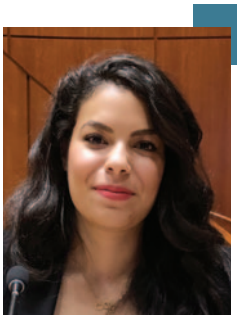
These steps are best undertaken as an iterative and dynamic process. Alongside the results of monitoring and evaluation, adjustments to existing adaptation measures or planning of new measures can also be informed by the latest science. The effectiveness of adaptation measures in the long-term – and the need for new or different measures – will also depend on the degree to which greenhouse gas emissions reductions are ambitious and are themselves effective at reducing the atmospheric concentration of carbon dioxide and other greenhouse gases.

The adaptation imperative

The IPCC's most recent scientific assessment of climate change impacts, adaptation, and vulnerability paints a stark picture of the current state of adaptation action worldwide. This assessment concluded that anthropogenic climate change "has caused widespread adverse impacts and related losses and damages" and that some of the impacts are irreversible as natural and human systems cross their adaptation limits.

What's more, the report warns that these risks and impacts are becoming more complex and harder to manage. For example, impacts and risks will transcend borders and cascade across sectors, and multiple climate-related hazards are likely to manifest simultaneously, resulting in an overall more challenging landscape of risk reduction and management.

At the same time, the IPCC concluded that adaptation is taking place across all regions and all sectors, which is yielding evident benefits, but that such efforts are so far fragmented and unevenly distributed, laying bare significant "adaptation gaps." Notably, the IPCC's report highlights aviation as one of the key vulnerable economic sectors in Europe that remains in the "earlier stages" of adaptation planning.



Fatin Tawfig
Associate Programme Officer, Adaptation Division, United Nations Framework Convention on Climate Change (UNFCCC)

> "To close these adaptation gaps, action across all sectors and segments of society is needed."

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> “To secure a resilient and sustainable future over the long term, the aviation sector must pursue a holistic approach to aligning itself with the key objectives of the Paris Agreement.”

To close these adaptation gaps, action across all sectors and segments of society is needed. Conventional wisdom holds that mitigation measures are well suited to private sector action because they offer relatively clear avenues to profit generation, whereas the business case for adaptation is often harder to make. Recent analyses have, however, challenged this view. Research by the Global Commission on Adaptation has found, for example, that investments in climate resilience boast benefit-cost ratios that range from 2:1 to 10:1. Benefits of investing in adaptation accrue what the Commission termed a “triple dividend” of avoided losses, economic benefits, and social and environmental benefits.

Adaptation under the United Nations Framework Convention on Climate Change and the Paris Agreement

Thirty years ago, the United Nations Framework Convention on Climate Change (UNFCCC) entered into force. This multilateral environmental agreement aimed above all to “stabiliz[e] greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system… within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.”

Despite being firmly anchored in the foundational document of the international climate change process, adaptation struggled to gain momentum and legitimacy alongside efforts to reduce greenhouse gas emissions. Whereas mitigation was viewed as addressing the source of the problem, adaptation was dismissed as a misguided attempt to divert resources to addressing the symptoms instead. Over time, however, the increasing frequency and severity of climate change impacts made abundantly clear the urgent need to adapt to climate change alongside efforts to cut emissions.

In 2015, the Paris Agreement established a global goal on adaptation, which strives to enhance adaptive capacity, strengthen resilience, and reduce vulnerability to climate change while contributing to sustainable development and ensuring an adequate adaptation response in the context of the Agreement’s temperature goal of limiting warming to 2°C, and pursuing efforts to limit warming to 1.5°C. As the name suggests, it is a global goal requiring a whole-of-society and economy-wide effort. Indeed, the Paris Agreement makes explicit that “adaptation is a global challenge faced by all with local, subnational, national, regional and international dimensions, and that it is a key component of, and makes a contribution to, the long-term global response to climate change.”

At COP 28, the most recent annual negotiating round of countries under the UNFCCC regime, the global goal on adaptation was further elaborated with a set of global targets and other key elements that should underpin efforts to build resilience to the worsening impacts of climate change. Specifically, the international community adopted the UAE Framework for Global Climate Resilience, which includes seven sectoral and thematic global targets to be achieved by 2030. These targets focus on water, food and agricultural production, health, ecosystems and biodiversity, infrastructure, poverty eradication and livelihoods, and cultural heritage.

Overall, the Framework and its targets are intended to shepherd the world towards a resilient future, marked by "the collective well-being of all people, the protection of livelihoods and economies, and the preservation and regeneration of nature, for current and future generations." It offers an indispensable guide to the coming generation of adaptation action, perhaps especially for a sector such as aviation, which is truly global in scope, with operations traversing borders, ecosystems, and sectors.

Adapting to climate change in the aviation sector

Comprehensive adaptation action in the aviation sector will require a wide range of actions, from ensuring that airfields and airports are protected against flooding, to safeguarding the health and safety of ground staff exposed to extreme weather conditions. Some work in this arena is already taking place. For example, the Get Airports Ready for Disaster initiative – a public-private partnership between the United Nations Development Programme, DHL Group, and Airports Council International – has been working since 2009 to strengthen the capacity of airports to respond to disasters.

In addition, another consideration is the importance of ensuring that efforts to reduce emissions are themselves resilient to the impacts of climate change; for example, the crops grown for sustainable aviation fuel will need to withstand droughts, floods, and other climate impacts.

Ultimately, to secure a resilient and sustainable future over the long term, the aviation sector must pursue a holistic approach to aligning itself with the key objectives of the Paris Agreement. This means undertaking both ambitious mitigation and adaptation actions with the urgency that this global challenge demands. ●

Fatin Tawfig has worked in the Adaptation Division of the United Nations Climate Change Secretariat for over five years. In this time, she has worked on issues such as the development of a new fund to support vulnerable countries in addressing climate change-induced loss and damage, understanding progress on adaptation, and assessing the state of global adaptation through the global stocktake of the Paris Agreement. She has also led technical analyses on topics such as adaptation technologies and finance, private sector resilience-building, and more.

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Climate change adaptation: how to factor in uncertainty

Climate change is currently a key factor that policymakers and stakeholders in the transport sector are tackling as a priority. Transportation accounts for over 20% of greenhouse gas emissions in the EU, with road transport being the main contributor, followed by waterborne transport and aviation at a considerable distance. Furthermore, transportation has additional impacts on the environment, including noise pollution and air quality degradation.

Andrei Mungiu
Team Leader, Environment and International Organisations, Aviation Policy Unit, DG MOVE, European Commission

The environmental impact of the transport sector would considerably increase in the near future if robust measures were not implemented. From an aviation perspective, the implementation of the Sustainable and Smart Mobility Strategy (SSMS) and the European Green Deal will make the EU air transport system more efficient and environmentally friendly. In alignment with the European Green Deal, the European Commission aims to reduce greenhouse gas emissions by at least 55% (compared to 1990 levels) by 2030 and achieve climate neutrality by 2050.

To achieve these ambitious and essential targets, strong strategic efforts are required over a sufficient period for the outcomes to be durable. During this timeframe and beyond, our society must learn to coexist with the effects of climate change; resilience and adaptation are primary in this regard.

In 2021, the European Commission adopted the new EU Strategy on Adaptation to Climate Change, planning the pathway to prepare for the inevitable impacts of climate change, regardless of mitigation efforts. As mentioned, the EU is combatting the exacerbation of climate change across all sectors, both domestically and internationally, but resilience to unavoidable events is crucial. We are already witnessing devastating phenomena such as deadly heatwaves, droughts, hurricanes and eroded coastlines in Europe and globally. Therefore, policymakers are also focusing their efforts on climate resiliency to protect citizens and infrastructure against present and future extreme weather events.

The EU Strategy on Adaptation to Climate Change was announced in the Commission Communication on the European Green Deal, following an evaluation of the 2013 Strategy in 2018 and an open public consultation in 2020. While EU policymakers' efforts are growing, even in the transportation sector, it is important to note that uncertainty and imperfect information are inherent in all fields of science and policymaking. A certain degree of unpredictability must always be considered.

The European Climate Adaptation Platform Climate-ADAPT (a partnership between the European Commission and the European Environment Agency) considers various approaches to address uncertainty in policymaking. These approaches may also be considered valid in climate change adaptation policies within the transport sector.

Climate ADAPT | SHARING ADAPTATION INFORMATION ACROSS EUROPE

They involve first of all considering multiple plausible outcomes, such as scenario planning, which entails comparing the results of alternative policy decisions under different future conditions.

A second possible strategy to address uncertainty in policymaking is adaptive management, which involves adjusting plans along the way as more is learned and discovered about the various issues at hand, with the purpose of achieving better performance. It is clear that continuous evaluation is fundamental to this approach.

A third potential approach to address uncertainty, according to Climate-ADAPT, might be represented by a resilient strategy, capable of effectively confronting a broader range of circumstances that may arise in the future.

Lastly, various strategies that may be more financially affordable have been listed, such as the so-called low-regret measures (low cost measures that produce benefits even in the absence of climate change), win-win strategies (which combine potential positive results towards climate risks with other social, environmental and/or economic benefits), or even the delay of decision-making (when there is no particular benefit in taking immediate action).

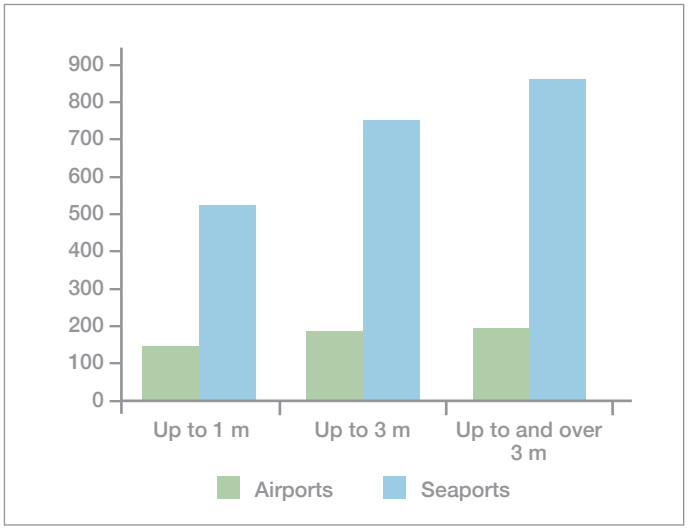
Focusing on the correlation between climate adaptation and the air transport sector, significant research is already underway to examine the impact of climate change on aviation. For instance, according to the Commission's Joint Research Centre PESETA III Science for Policy Summary Series, several airports currently lie within the coastal zone of Europe (EU and non-EU), placing them at risk from rising sea levels. While airports are generally designed to withstand coastal floods up to a water depth of 1 m, by the end of the century, approximately 200 airports of varying sizes across Europe could face the risk of inundation due to higher sea levels and extreme weather events. Airports along the North Sea, particularly in the United Kingdom, Germany and Norway, are the most affected.

Similar risks are faced by airports located near rivers: although in smaller numbers, several European airports are at risk of inundation levels ranging between 1 and 3 metres from extreme river floods (statistically expected to occur with a 1% annual probability).

The increasing focus on climate adaptation, while considering uncertainty, will be crucial during the upcoming years' activities of EU and global policymakers. The European Commission will continue to incorporate climate resilience considerations into all relevant policy fields, including air transport.

The unpredictability and strength of such manifestations may impact the transport system at various levels, affecting both its infrastructure and its own activity, potentially posing significant risks to the reliability and safety of passengers. This circumstance is particularly relevant as extreme weather events become more frequent. At the same time, economic losses from more frequent climate-related disasters are rising, with studies indicating that exposing the EU economy to global warming of 3°C above pre-industrial levels would result in an annual loss of at least €170 billion.

Climate change adaptation is therefore becoming crucial among EU policymakers' efforts. The aforementioned SSMS laid the groundwork for how the EU transport system can achieve its green transformation while simultaneously becoming more resilient to climate change. More precisely, infrastructure must be adapted to climate change and fortified against potential severe natural events and disasters. Examples include protection with dykes and levees, or elevation of critical infrastructure.



> To achieve these ambitious and essential targets, strong strategic efforts are required over a sufficient period for the outcomes to be durable.

The latest revision of the TEN-T Regulation, in line with the ambitious agenda of the European Green Deal, serves as a prime example of the Commission's plan for climate resilience and adaptation in the transport sector. Improving transport infrastructure (including airports), and fortifying services against disruptions and climate change through specific upgrades and design are crucial. Furthermore, infrastructure projects under the TEN-T Regulation should be resilient to the potential adverse impacts of climate change through a "climate vulnerability and risk assessment".

By 2026, the European Commission, in close cooperation with the Member States concerned, will also conduct an assessment of the resilience and vulnerability of the core network to the consequences of climate change. Climate-proofing is then planned for projects of common interest that require an environmental impact assessment.

The European Commission's focus on resilience and climate change adaptation in the transport sector is growing, not only through policymaking but also as a main topic in major public debates (e.g. Connecting Europe Days).

Accordingly, the increasing focus on climate adaptation, while considering uncertainty, will be crucial during the upcoming years' activities of EU and global policymakers. The European Commission will continue to incorporate climate resilience considerations into all relevant policy fields, including air transport. ●

Andrei Mungiu has been engaged in EU environmental policies since 2012, specialising in aviation from 2017. A member of the European Aviation and Environmental Group since 2017, he has served as co-chair since 2023. At the UN level, he is the EU observer to ICAO's Committee on Aviation Environmental Protection. He has extensive experience in the private sector including in software management across multiple countries.

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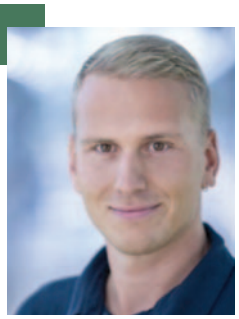
Planning for adaptation: climate risk assessment and opportunities

Munich Airport's climate change adaptation approach – investigating and managing the impacts of heavy rainfall from the perspective of an airport

Munich Airport has set ambitious goals within its net-zero strategy: from 2035 at the latest, the operation of the airport aims to no longer leave any CO_2 in the atmosphere. Over the past decade, numerous measures have already been successfully implemented towards this goal. However, alongside climate protection, the airport is also pursuing an adaptation strategy to address the inevitable consequences of climate change. One consequence will be increasingly frequent and intense rainfall events in the future. These events are characterised by severe storms and exceptionally high precipitation levels over a short period, presenting significant damage potential. They can occur unpredictably at any place. Understanding the implications of these events on airport infrastructure, identifying vulnerabilities, and devising strategies to mitigate potential damage and operational disruptions are critical considerations. To address these concerns, a drainage model has been developed within the Environmental Department of Munich Airport. This model accurately simulates flood runoff scenarios and facilitates the identification of hazardous areas. The results provide an excellent basis for the determination of countermeasures.

Hermann Blomeyer
Vice President, Head of the Environmental Department, Munich Airport



Johannes Jell
Expert for Heavy Rainfall Risk Management, Environmental Department, Munich Airport

Munich Airport is situated in the north eastern region of Munich and is surrounded by the Isar River and various smaller streams, mainly flowing from southwest to northeast. Flood protection measures were already implemented during the airport's construction in the early nineties, including the construction of dikes and ditches around the airport. These measures are designed to capture and safely discharge water during flood events with a return period of 100 years. However, how does the airport's infrastructure respond to extremely rare and intense rainfall and flood events? To assess if the drainage system is hydraulically capable of dealing with enormous amounts of water and to identify potential hazard areas on the airport premises, a heavy rainfall risk management strategy was initiated. The approach followed guidelines specified by the Water Management Authority and the standards of the German Association for Water, Wastewater, and Waste (DWA).

How does the airport's infrastructure respond to extremely rare and intense rainfall and flood events?

Munich Airport established a three-pillar approach to assess and mitigate the risks of heavy rainfall and flash floods (see below).

HAZARD ANALYSIS: A key component in analysing flood risks is the development of a hydrodynamic 2D runoff model, which enables the calculation and visualisation of runoff in response to a precipitation event. Utilising survey data, the airport and its surrounding water catchment areas are reconstructed as a digital terrain model. Hydraulic and hydrological factors, as well as precipitation-runoff conditions, are assigned to each element of the model based on the type and use of the surface. In addition to the 2D runoff model, a complex hydrodynamic sewer network model is used to investigate

Hazard Analysis	Risk Assessment	Measures
• 2D flood modelling • Analysis of water level • Identification/ visualisation of hazard zones	• Analysis of vulnerability and damage potential • Risk communication • Prioritisation	• Operational and emergency plans • Water resistant constructing • Flood protection and retention

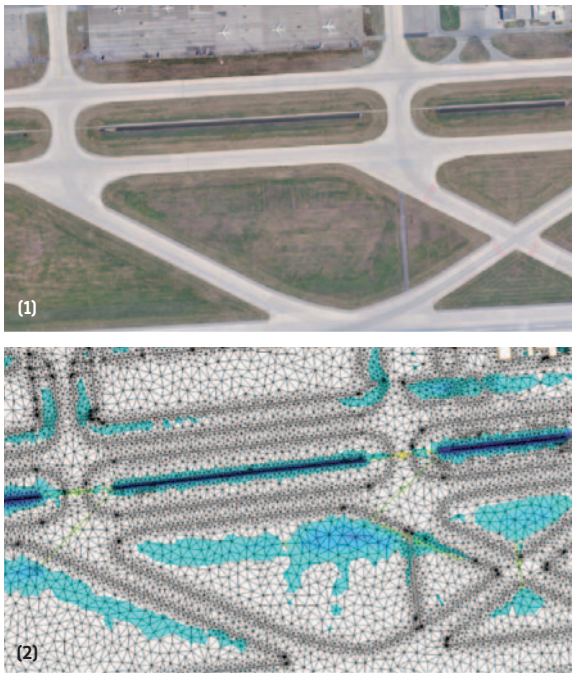
the impacts of heavy rainfall on the airport's sewer system. This model is capable of calculating sewer water levels, discharges, and overflow volumes, which can also be transferred and evaluated in the 2D runoff model. The results enable detailed and realistic calculation of flood depths, flow directions, and velocities within the study area. These outcomes can be visualised using hazard maps and animations, facilitating precise identification of hazard zones in the airport's infrastructure.

RISK ANALYSIS: The second step of the investigation involves the precise assessment and analysis of hazard zones. Floods can predominantly affect operational areas, buildings, green areas, and transportation infrastructure. Common risks within the airport infrastructure include water entry into buildings, operational constraints, traffic disruptions, as well as disruptions to computer and IT systems. However, not every flood event is necessarily dangerous and carries a high potential for damage. A precise risk assessment requires interdisciplinary collaboration, ideally under the guidance of a proficient heavy rainfall prevention manager. Tools such as information leaflets, checklists, and particularly animations can be used for risk communication. The results of the risk assessment should be centrally collected and evaluated. Special attention must be given to particularly vulnerable areas of the airport – proactive measures should be taken as soon as possible.

MEASURES: The third step aims to plan and implement preventive measures to minimise the potential damage caused by flooding. This can be achieved through operational and organisational measures, such as regular inspection, maintenance, and cleaning of the drainage system, as well as the establishment of alarm and emergency plans. Furthermore, a resilient drainage infrastructure should be considered in constructional projects: green roofs, decentralised rainwater management, and high-capacity drainage systems contribute to reducing peak discharges. For particularly vulnerable areas, structural measures can effectively mitigate the risk of flash floods, such as terrain adjustments, object protection measures, and the creation of retention areas for uncontrolled runoff water.

Case study: hazard analysis for extremely intense rainfall events at Munich Airport

The 2D surface model of Munich Airport is based on the digital terrain model at a 1-metre grid resolution provided by the Bavarian State Office for Digitalization, Broadband, and Surveying. It covers an area of approximately 230 km^2 and includes all significant watershed areas draining towards the airport premises. Where available, the digital terrain model was also refined using proprietary survey data. The grid was developed with the support of a specialised engineering company and serves as the foundation for the surface runoff simulation.

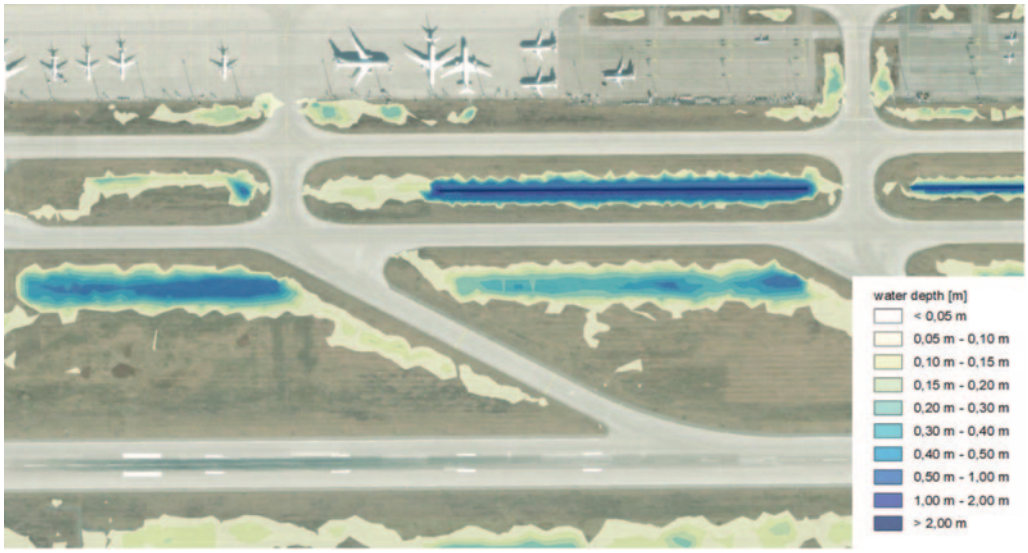


Aerial view of runways, captured by Google Earth (1) and corresponding digital terrain model at Munich Airport (2)

The selection of appropriate precipitation scenarios for the runoff simulation at Munich Airport was carried out in close coordination with the water authority following the guidelines provided by the Bavarian Environment Agency and the Bavarian State Ministry for the Environment and Consumer Protection.

SCENARIO 1
1000-year river flood event

The capacity of riverbeds and ditches around the airport is hydraulically assessed for a flood event with a return period of 1000 years. It became evident that the existing flood protection facilities are adequately dimensioned for such extreme events. Flood discharges from the southern water catchment area can be safely diverted around the airport. Therefore, widespread floodings are not expected.



2D runoff model showing flooded areas and water depths in the vicinity of aviation areas

Hermann Blomeyer studied civil engineering at the Technical University of Munich and began his career at the Bavarian State Construction Ministry. Then he joined the Bavarian State Ministry for the Environment and Consumer Protection, where he was engaged with various aspects concerning water management. Since 2005, he has been employed at Munich Airport, playing a key role in the planning of its expansion (3. Runway) and leading the Environmental Department since 2012, focusing on various aspects including air quality, climate protection, noise reduction, water management, and nature conservation. He is a member of various national and international environmental committees.

Johannes Jell graduated in environmental engineering at the Technical University of Munich and has since been working as a planner and consultant in the field of water management. Currently, he is leading the Heavy Rainfall Risk Assessment in the Environmental Department at Munich Airport, and contributes to a heavy-rainfall-adapted development of the airport's infrastructure.

SCENARIO 2
100-year rainfall event

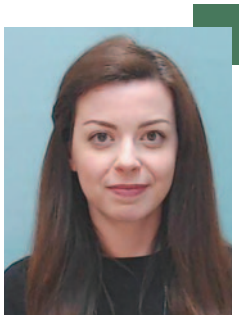
In order to assess the drainage performance within the airport premises, the digital terrain model was augmented with a hydrodynamic sewer network model and subjected to a rainfall event with a return period of 100 years. The results have shown that the airport's sewer system is resilient and efficient, although localised flooding is possible – also caused by sewer overflow.

The model can also be used in the future for additional selected precipitation scenarios. Currently, Munich Airport aims to simulate an even more extreme precipitation event, which can occur independently of statistical probabilities anywhere in Bavaria. This event is characterised by an intensity of 100 mm in one hour. Additionally, the model is further updated and refined in highly vulnerable areas. This includes the integration of drainage channels, gullies, and infiltration systems in order to obtain small-scale and object-related results.

Towards a climate-resilient airport: strategies and recommendations

As a result of climate change, airports are compelled to take proactive measures. Mitigating greenhouse gas emissions like CO_2 has been a longstanding priority. Munich Airport has already implemented a range of environmental protection measures. These include promoting renewable energy sources, transitioning the vehicle fleet to electric-powered vehicles, upgrading electrical systems and installations to enhance energy efficiency, and investing in environmentally friendly practices for new constructions and renovations. Nevertheless, climate adaptation is gaining more and more prominence at Munich Airport, addressing the inevitable impacts of climate change, such as the increase in frequency and intensity of extreme rainfall events. Among the proactive measures being implemented is the development and deployment of a resilient drainage infrastructure. By greening surfaces and roofs, initial runoff peaks are mitigated, evaporation is encouraged, and the local microclimate is improved. Where feasible, clean rainwater is being collected and returned to groundwater through decentralised infiltration systems, thereby sustaining the natural water cycle. Furthermore, there is a growing recognition of the importance of flood calculations in safeguarding airport infrastructure and operations against the adverse effects of heavy rainfall. Employing hydraulic modelling emerges as the most effective means of assessing the impacts of heavy rainfall events. An important aspect of this process is ensuring the availability of comprehensive and accurate data, which forms the foundation for generating realistic and reliable results. Evaluation of these results necessitates a wealth of expertise, and effective communication is paramount for success. It is essential to articulate and visualise findings in a manner that is both logical and easily understandable. At Munich Airport, efforts to raise awareness and devise solutions for heavy rainfall preparedness involve leveraging videos and checklists to engage relevant stakeholders. However, the journey does not end with conceptualisation and discussion. It is imperative to translate these ideas into concrete actions and consistently implement them to achieve tangible outcomes. ●

Airports tackling climate change – the case of 14 regional airports in Greece



Maria Christopoulou
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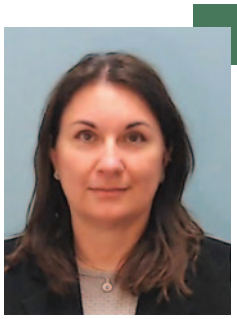

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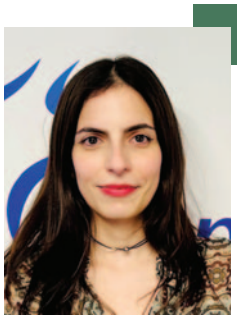

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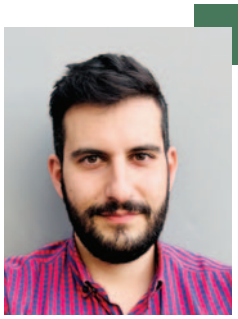


Antonis Boutsakis
Airport Planning Engineer, Fraport Greece

Human influence has warmed the atmosphere, ocean and land, causing widespread and rapid changes to the earth's climate (Intergovernmental Panel on Climate Change (IPCC), *Sixth Assessment Report, 2021*). More extreme weather and other climate-related events are projected as the climate continues to change. The frequency, intensity, spatial extent, duration and timing of extreme events are expected to increase, making airports around the world more vulnerable to climate change-related risks, and causing flight disruptions and cancellations (*Airport Council International (ACI) Policy Brief, 2018*). It is imperative for airports to identify the risks and implement adaptation measures for both existing and new infrastructure, and at the same time manage critical operations to increase resilience to the changing climate.

Airport Council International resolution and policy brief on resilience and adaptation to climate change (*ACI Policy Brief, September 2018*) provided airports with recommendations with regard to adaptation planning through:

- considering the potential impact of climate change when developing master plans;
- conducting risk assessments of aircraft operations and infrastructure based on potential climate impacts;
- developing and incorporating actions at an early stage according to the risk assessment, in line with the overall business plans and emergency plans;
- developing effective communication channels with all airport stakeholders and local emergency management officials.

More importantly, and related to the ACI policy brief, Fraport Greece (FG) incorporated a "Climate Change Resilience Study" in the master plans of the 14 regional airports in 2017. This study was updated in 2022 in cooperation with the National Observatory of Athens (NOA). The key objective was to ensure that climate-related risks affecting the airports were identified early on and managed effectively by integrating the results in the airports' first master plan update.

> It is imperative for airports to identify the risks and implement adaptation measures for both existing and new infrastructure, and at the same time manage critical operations to increase resilience to the changing climate.

The risk assessment was a desk-based due diligence review, and the analyses by NOA covered three different time periods: short term (2022-2031), medium term (2032-2041) and long term (2042-2056).

The regional climate change projections followed the IPCC intermediate mitigation scenario Representative Concentration Pathway, RCP4.5 (limited climate mitigation) and the IPCC high-emissions scenario, RCP8.5 (no climate mitigation policies).

A set of climate change indicators (Table 1) were correlated to certain airport-related risks that may affect operations and/or airport infrastructure.

Risk source; climate change indicator	Risk	Affecting: operations and/or infra-structure
Temperature; T_{max} > 35°C	Flashpoint (38°C) of aviation fuel exceeded on very hot days – potential fire hazard.	Both
Fire; FWI & FWI > 50	Increased fire risk due to higher temperatures and increased summer drought potential.	Both
Temperature; T_{max} > 35°C	Reduced lift for departing aircraft due to "thin air" and reduced engine efficiency in very hot weather.	Operations
Fog (warm sea & cold air)	Low visibility due to fog conditions could cause disruption and delays.	Operations
Wind changes; air speed	Wind intensity affects runway utilisation and schedules. Increased risk of wind damage to assets, standing aircraft, vehicles and injuries to staff.	Both

Table 1
Correlation of climate change indicators with risks and their effect in operation and/or infrastructure

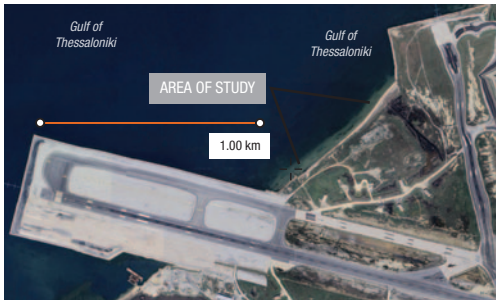
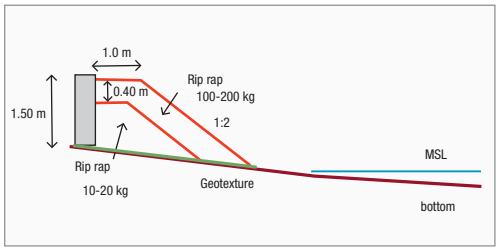


Image 1 – The area of study is located between the two crossing runways (16-34 & 10-28) of Thessaloniki Airport

Image 2 – Typical cross section of rip rap wall proposed for Thessaloniki Airport (SKG) coastline



Colour-coded risks were classified into three categories, depending on consequences on airport infrastructure and/or operations.

Low risk	Posing little or no threat
Moderate risk	Having some impact but in manageable levels
High risk	Having significant impact with unacceptable level of service

Table 2
Classification of risks

The risk review did not identify any high risks over the short-term period (2022 – 2031) and therefore no immediate action was deemed necessary, and no specific actions needed to be included in the update of the master plans.

For the medium and especially the long-term periods, **sea level rise** becomes a **"high"** risk for four airports: Thessaloniki, Corfu, Rhodes and Aktion. Sea level rise is projected to become progressively more severe, and large impacts are expected for the period after 2050. Taking this into consideration and in conjunction with the airport's Approved Environmental Terms, Fraport Greece proceeded with a preliminary study for the protection of the coastline at Thessaloniki Airport (Image 1) in cooperation with the department of Coastal Engineering of the Aristotle University of Thessaloniki (AUTH), in 2022. The study concludes that a rip rap wall will protect the coastline from erosion and consequently future sea level rises. The rip rap wall immediately stabilises the coastline and is designed to protect it from the synergy of storm tides, wave height and permanent sea level rise (0.30 m) due to climate change.

Similar adaptation measures are to be included in future revisions of the master plans.

Although **temperature**-related risks (including fire) are classified **"moderate"**, **all airports** will experience an increase in (some) temperature-related risks. Unfortunately, Rhodes Airport experienced extensive wildfires in 2023 that created a major negative impact to the environment and affected the whole island. The operation of the airport was severely affected having to accommodate a large number of tourists and traffic. Financial loss was also significant as traffic was affected.

Higher temperatures will increase the energy needs for cooling significantly, thus greatly increasing costs (especially with current – rising – energy prices) and related emissions. Appropriate cooling measures, relying on architectural solutions and green spaces, will be explored and included in future revisions of the master plans.

> Climate change is already showing its impacts and the better prepared airports are, the more resilient they will become.

Also, increasing **drought** will constrain future water availability and increase costs at all airports. Suitable measures, per airport, will be explored, such as water recycling and water use savings and will be included in future revisions of the master plans.

Other "moderate" risks that are **airport-specific** include: floods (Thessaloniki, Kavala, Zakynthos, Aktion, Kefalonia, Rhodes and Samos), sea level rise affecting access (Kavala, Skiathos, Zakynthos, Samos and Mytilini), increased wind speed (Corfu, Rhodes, Samos, Mytilini, Mykonos and Santorini), and fog (Thessaloniki). Skiathos Airport experienced major floods in the surrounding area following heavy rainfall events in September 2023. Access to the airport was disrupted, and extensive flight and systems failures created severe problems to airport operations. Fraport Greece, in an effort to safeguard all critical infrastructure at those airports and in a proactive approach to tackle the emerging risks related to climate change, has progressed with the development of various hydraulic models and risk assessments related to flood events in vulnerable airports such as Thessaloniki, Santorini and Zakynthos.

Besides the assessment of climate-related risks and the measures to control them, synergies and cooperation within the aviation industry and governmental organisations will prove very useful. Fraport Greece is participating in ACI's working group for European Aviation Climate Change Adaptation, in an effort to further elaborate on adaptation measures and actions planned at airports in Europe and in the aviation sector in general. At the same time, Fraport Greece is planning to conduct climate change resilience studies per airport, making it site-specific and assessing the local conditions, since there is great diversity in terms of local climate conditions, climate-related risks and local environment. Climate change is already showing its impacts and the better prepared airports are, the more resilient they will become. ●

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Overview of Thessaloniki Airport

Maria Christopoulou, environmental expert at Fraport Greece, is a member of the environmental team and has 17 years of experience in the environmental impacts of various projects.

Clary Raftopoulou, environmental manager at Fraport Greece, is an environmental expert with 25 years of professional experience in environmental management and sustainability in the aviation sector.

Christos Giannakopoulos, research director at the National Observatory of Athens, is a member of the Climate Change Impacts Study Committee formed by the Bank of Greece, and IPCC focal point for Greece.

Eva Tsiliakou, aviation geospatial engineer at Fraport Greece, is a surveyor engineer involved in aviation safety projects and development studies for FG airports.

Antonis Boutsakis, airport planning engineer at Fraport Greece, is a civil engineer managing terminal and apron capacity assessments, traffic forecasts and master plans.

References

- CLIMADAPT: CLimate change IMpacts and ADAPTation group; Dr Christos Giannakopoulos, author team of *Update of the 2017 Climate Change Study for the 14 Regional Airports of Fraport Greece*, Tim Van de Schriek, Nikos Roukounakis, Anna Karali, Gianna Kitsara, Giannis Lemesios, Myrto Gratsea.
- Professor Karambas Theophanis, Coastal Engineering and Coastal Protection, *Technical study for Coastal Protection of Thessaloniki Airport.*

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Aeroporti di Roma's strategy on climate change risk management

The growing global awareness of the impact of climate change requires companies to develop a concrete commitment to face this new challenge. Aeroporti di Roma's (ADR) approach not only aims at mitigating climate change through the objective of reaching net-zero emissions from its airports by 2030 but also extends to the in-depth analysis and management of the risks that climate change will bring in the coming years.

Marco Troncone
Chief Executive Officer,
Aeroporti di Roma

ADR's vision embraces a deep understanding of how climate change can affect not only operations and safety of our airport infrastructures but also the economic sustainability and long-term resilience of the business.

ADR recognises that climate changes present multi-dimensional risks, therefore the significant economic implications of such risks cannot be ignored. The increase in operating costs, potential impacts on revenues, the impact on our ability to attract investments and access capital markets are all factors that require careful evaluation and management. Moreover, the evolution of the global climate scenario may require an increase in insurance coverage for managed assets, implying the need for extraordinary investments for the modernisation or reconstruction of potentially damaged structures. These economic factors are closely interconnected with corporate reputation, being essential to maintaining stakeholder trust and ensuring the long-term financial sustainability of our business.

To address these risks and seize the related opportunities, ADR has implemented a cutting-edge methodology of "Climate Change Risk Analysis", which aligns with and surpasses international best practices, including the ICAO guidelines and ISO 14091 *Adaptation to climate change – Guidelines on vulnerability, impacts, and risk assessment.*

Essentially, the risks associated with climate change fall into two categories:

- Physical risks, related to the physical impacts of climate change. These can be acute, caused by specific extreme weather events, such as storms, floods, or droughts; or chronic, caused by long-term changes in climate patterns, such as the constant increase in temperatures, sea level rise, and longer and more frequent heatwaves.
- Transition risks, related to the transition to a low-carbon economy. These include, for example, risks associated with the evolution of climate policies and regulations, initiatives for carbon emission zeroing, policies related to CO_2 taxes, energy and fuel costs, and national or global energy policies.

The organic approach and in-depth analysis of possible scenarios have been integrated into Aeroporti di Roma's Enterprise Risk Model (ERM), allow-

ing for the identification, evaluation, and management of climate risks with a long-term perspective, going beyond the traditional three to five-year time horizons typical of industrial planning.

ADR's climate change risk assessment (CCRA) methodology includes:

- Advanced climate modelling: through the analysis of climate trends performed using historical data and future projections (using local meteorological databases and datasets with high spatial/temporal resolution), climate modelling of relevant hazards is carried out, combining different time horizons (2030, 2040, and 2050) and climate scenarios developed by the IPCC (Intergovernmental Panel on Climate Change, the United Nations body for the assessment of climate change science).
- In-depth analysis of potential impacts: examines how climate change could specifically affect assets and operations, including a detailed assessment of transition risks related to the evolution of the regulatory and market context.
- Resilience assessment: through an integrated analysis, the capacity of infrastructure and operational procedures to manage and adapt to climate impacts is evaluated, ensuring that the organisation remains resilient in the face of changes.
- Development of a strategic adaptation plan: based on the analyses, an adaptation plan is defined that includes short-, medium-, and long-term measures to increase climate resilience, simultaneously identifying opportunities emerging from the transition to sustainable mobility.
- Board/top management commitment: results of climate risk analyses and adaptation plans are updated regularly and shared with board and top management, ensuring full awareness at all corporate levels and a continuous updating in line with the latest scientific evidences and international best practices.

A fundamental aspect of the strategy is adherence to the principles of the European Taxonomy for Sustainable Investments, which provides a robust framework for classifying activities based on their sustainability, and which takes into consideration resilience to climate changes especially for infrastructure managers like Aeroporti di Roma. This, therefore, also allows us to align with the most advanced standards for financial transparency, ensuring even more that every investment decision and every mitigation and adaptation strategy is aligned with the objectives of creating long-term value.

Conducting a climate change risk assessment places Aeroporti di Roma at the forefront of managing environmental sustainability issues. Through this approach, ADR wants to rigorously address the issue of climate change risks, demonstrating with concrete actions the commitment to climate resilience, in line with global objectives and the expectations of our stakeholders. ●

Marco Troncone joined Aeroporti di Roma in 2011, initially dealing with strategic planning and relations with the board, and then as chief financial officer.
He was appointed as CEO in April 2020. He is vice president of Aéroports de la Côte d'Azur, elected vice president of infrastructure for growth at Unindustria, a member of the board of ACI EUROPE, and chairman of the Foundation for the Decarbonisation of Air Transport. Graduated in chemical engineering from the Federico II University of Naples, he has a master's degree in business administration from SDA Bocconi.

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United Kingdom's aviation approach to climate change adaptation

Dr Rannia Leontaridi OBE
Director General for Civil Aviation,
Department for Transport,
United Kingdom

> "In 2023, over 340 000 air traffic flow management (ATFM) delay minutes were due to weather. This accounted for 46% of the total ATFM delay minutes [1]."

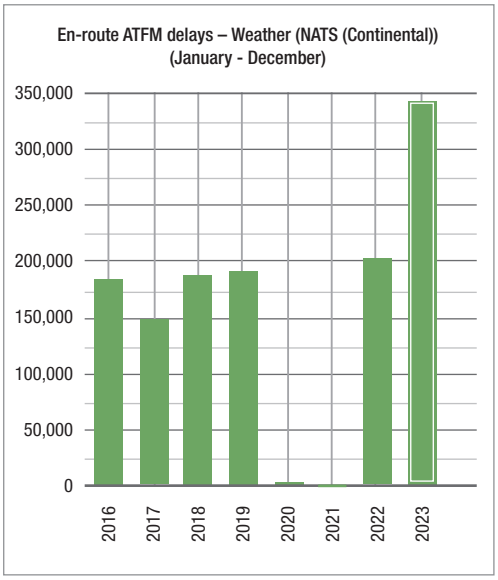
Impacts of a changing climate on aviation

The United Kingdom, like all nations, is already experiencing the effects and the challenges of a changing climate. Impacts are being felt across the economy and cannot be ignored within aviation. Most notably for our sector, in recent years we have observed the clear link between severe weather and operational performance. In 2023, over 340 000 air traffic flow management (ATFM) delay minutes were due to weather. This accounted for 46% of the total ATFM delay minutes [1]. The impact to operational performance is one of many far-reaching consequences to aviation of our changing climate.

Through the UK's pioneering Climate Change Act in 2008, the UK government has committed to aiding climate change adaptation across sectors. Now, with the government's new transport climate change adaptation strategy, we will ensure there is a renewed and holistic approach to climate adaptation across the transport sector.

Recent years have brought home the challenges aviation faces in ensuring operations and infrastructure are resilient to climate change. In July 2022, UK temperatures exceeded 40°C causing a previous area of repair work on Luton Airport's runway to de-bond, resulting in a two-hour runway closure. Storm Eunice, in February 2022, caused significant disruption to UK airports – at London Heathrow alone there were 40 "go arounds" [2]. These events demonstrate the severe challenges the aviation sector faces and the potential for passenger disruption.

These are not isolated events. The increasing frequency and severity of extreme weather across the globe has the potential to impact our globally interconnected aviation network. In August 2023, this was apparent for UK aviation with wildfires on the Greek islands of Rhodes and Corfu displacing holidaymakers, requiring repatriation flights and halting some flight operations to the islands for up to a week.



Source: Balanced Scorecard (eurocontrol.int)

Events such as this show that it is crucial to build a coordinated global effort to address climate risks and adapt to climate change. It is only through a coordinated and effective approach to climate risks that we can look to reduce future costs and improve resilience for the aviation sector.

Aviation is a vital part of the UK economy, with air transport and aerospace sectors contributing around £20 billion per year [3] and directly providing approximately 230 000 jobs [4]. In 2023, UK airports handled over 270 million terminal passengers, with direct routes to over 100 countries, providing the primary international link for the UK [5]. The volume of terminal passengers handled in 2023 was 23% higher than in 2022 but was still 8% lower than the volume handled in 2019. Resilience of the aviation sector to climate risks is crucial to ensure continued movement of goods and people.

The aviation sector is adept at managing climate risks, as UK airports, airlines, and air traffic service providers are already undertaking steps to ensure that climate risks are addressed and integrated as part of business activities. This is evident through the many aviation organisations that undertake

(1) EUROCONTROL Balanced Scorecard (n.d.) https://www.eurocontrol.int/Economics/BalancedScorecard.html
(2) UK Met Office (2022) "Behind the scenes of Storm Eunice and landing aircraft safely".
(3) Department for Transport (2023) DfT analysis of *ONS Business Register and Employment Survey.*
(4) Department for Transport (2023) DfT analysis of *ONS Business Register and Employment Survey.*
(5) Department for Transport (2022) *Jet Zero Strategy, Delivering net zero aviation by 2050.*

reporting to the UK government as part of the Climate Change Act, as well as those that report under the Taskforce for Climate-Related Financial Disclosures framework. In addition to this, many parts of the sector regularly undertake climate risk assessments, analysis and monitoring of critical infrastructure and operations in line with current and emerging climate scenarios.

The UK Civil Aviation Authority has an active role in supporting the UK aviation industry in being prepared for climate change. They ensure that specific areas including noise, air quality, and biodiversity, are considered within regulation and oversight, encouraging the sharing of best practice, and contributing to the development of international initiatives that target climate risks.

Despite strong progress being made across the sector on all areas of climate risk understanding and mitigation, there is still a need to drive improvements and consistency to limit the disruptive impacts from climate change. It is through ever closer working between industry, regulators, and governments that we can truly improve resilience to climate risks across the aviation sector.

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> As an aviation network, there is limited benefit if only some parts of the network are well adapted to climate risks. We need all aspects of the aviation network to be resilient to climate change if we are to stay connected and grow the economy.

Transport adaptation strategy: a strategy to deliver a network fit for a changing climate

In 2008, the UK passed pioneering legislation in The Climate Change Act 2008 [6] (The Act), which has remained the linchpin of the UK government's approach to adapting for the impacts of climate change. The Act commits the aviation industry to providing regular reports on its preparedness for climate change risks [7]. The Act also commits the UK government to produce a UK Climate Change Risk Assessment (CCRA) every five years, and a National Adaptation Programme (NAP) to set out the actions of UK government and public bodies to mitigate the climate change risks. The most recent NAP was produced in July 2023 [8].

Even with having this framework in place, climate change adaptation is still not consistent across many parts of the UK transport sector and is not being translated at sufficient pace with the current emissions scenarios [9]. Therefore, within the latest NAP, the Department for Transport (DfT) committed to producing a transport adaptation strategy that will take a holistic approach to addressing the transport-related risks in the third CCRA [10]. The transport climate change adaptation strategy will aim to maintain the momentum and focus on adaptation in the five years between CCRA, driving progress, ambition and action.

The transport adaptation strategy will aim to enhance adaptation planning across the sector, ensuring plans are delivered and lead to improved climate resilience for the entire transport system.

(6) Climate Change Act (2008) c.27. https://www.legislation.gov.uk/ukpga/2008/27/contents
(7) UK government (2022) "Climate change adaptation reporting: third round reports".
(8) UK government (2023) *Third National Adaptation Programme.*
(9) Intergovernmental Panel on Climate Change (2023) *Climate Change 2023 Synthesis Report - Summary for Policymakers.*
(10) UK government (2022) *UK Climate Change Risk Assessment 2022.*

Dr Rannia Leontaridi OBE joined the UK's Department for Transport (DfT) in 2020 as director general for civil aviation. Her previous roles include as director for business growth, and director for the Office for Artificial Intelligence, leading the government's policy on AI as well as entrepreneurship, small businesses and new emerging high-growth and technology businesses.

Rannia also led the development of more than 100 employee-owned private sector businesses. Starting her professional life as an entrepreneur, she later became a lecturer in economics. She received an OBE for public service in 2016, and is a Carnegie scholar in economics and a Fellow of the Royal Society for the Arts.

The policies and actions included have been grouped into four themes. These overlap and support each other, with collaboration underpinning everything:

- Culture: Embedding climate risk
- Economics: Making the case for change
- Regulatory: Setting the long-term direction
- Collaboration: Sharing knowledge and best practice.

The upcoming consultation on the transport adaptation strategy will build upon the positive progress already undertaken by the aviation sector, encouraging cross-industry engagement and coordination to adapting and developing resilience. Through the development of the transport adaptation strategy, DfT has regularly engaged with the aviation sector to develop attainable and achievable actions the sector and government can progress. These actions include:

- **Knowledge building** – exploring the best methods of information and data sharing of extreme weather events to improve sector knowledge of climate risks.
- **Reporting on climate risk** – raising the profile of climate adaptation within organisations, through improved monitoring systems and uptake of reporting of climate risk.
- **Embedding climate risk** – enhancing aviation industry knowledge on climate impacts and adaptation, through development of adaptation and risk assessment guidance.
- **International collaboration** – strengthening coordination and engagement with international forums and best practice on climate adaptation.

As an aviation network, there is limited benefit if only some parts of the network are well adapted to climate risks. We need all aspects of the aviation network to be resilient to climate change if we are to stay connected and grow the economy. The transport adaptation strategy will put the aviation sector on a pathway to realising this vision, driving adaptation across operators and encouraging cross-sector collaboration.

Final remarks

There is not a one-size-fits-all approach to climate adaptation and addressing climate risks, and great strides to build resilience to climate change have already been taken. However, climate change is a risk that is only going to increase. The UK's transport adaptation strategy is a key step in raising climate change adaptation ambitions for the aviation sector. We are committed to working closely with the aviation sector to address knowledge gaps, utilising our unique international position to raise the profile of climate adaptation with ECAC Member States and encourage cross-industry coordination for building a climate-resilient aviation sector at a European and international level. ●

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How climate change adaptation can contribute to a more robust civil aviation

Heavy rainfall and storms, sea rise levels and unprecedented heatwaves are extreme weather phenomena associated with climate change. Civil aviation is vulnerable to certain weather conditions, and in order to secure an efficient, available and safe aviation sector, the Swedish Transport Agency is working systematically with climate change adaptation.

In Sweden, we have witnessed several examples of extreme weather, such as an unprecedented heatwave in 2018 that caused forest fires, and extreme downfalls in 2021. We anticipate that these situations will increase due to climate change and we believe there is a risk that civil aviation can be affected by these altered conditions. Changes in climate lead to a vulnerability for all transport modes and infrastructure, and may cause disruption of various degrees.

> The responses from airports and heliports indicate that no major changes are currently observed as a result of a changing climate.

In 2018, the Swedish government launched the national Climate Adaptation Strategy and the Ordinance on the Swedish authorities' climate change adaptation work. The Strategy includes national goals for climate change adaptation and aims to strengthen the work at a national level, while the Ordinance regulates the authorities' action plans in certain specified areas. Both the Strategy and the Ordinance are important tools for the Swedish Transport Agency's efforts to increase resilience, which is crucial for maintaining a safe aviation sector amidst a changing climate, and preventing disruptions.

In 2005, the Agency initiated an operational status report that is distributed annually. The report is an integral component of our comprehensive regulatory oversight of aerodromes and aerodrome operators within the country. Since its inception, the report has become a critical tool for systematically gathering and analysing information on planned infrastructure measures, improvements, and potential deficiencies within aerodrome operations.

The purpose of the operational status report extends beyond mere data collection. It aims to provide an in-depth understanding of the ongoing and future development plans of aerodromes and aerodrome operators. By highlighting areas typically outside the scope of regular activities, the report enables a proactive approach to oversight, ensuring that potential issues can be identified and addressed at an early stage. The information obtained through this annual reporting process is utilised not only for planning and strategic development but also as a fundamental basis for monitoring and evaluating implemented measures. This affords the regulatory authority the opportunity to refine its oversight methods and focus on specific areas for improvement based on real and current data. Furthermore, the operational status report plays a crucial role in promoting transparency and accountability among aerodrome operators.

In the operational status report sent out in 2022, all Swedish aerodromes and heliports were asked to analyse how climate change had affected the availability, such as delays, airport closures, etc. due to certain extreme weather events during 2021. Four questions were asked:

- In what way does the airport work with climate change adaptation today, for example in risk and vulnerability analyses, risk management, routines, new/changed systems, changed design of infrastructure, etc.?
- In what way have weather-related events, such as large rainfall, high temperature, less frost, zero crossings and more, affected availability in 2021?
- Do you consider that significantly increased intensity in heavy rain or more rain during longer rainy periods could result in complications for air traffic at your airport?
- If groundwater levels increase, do you see that there is a risk for other issues, for example water collecting in cable ducts that could affect the airport's electrical systems, or other problems such as water-saturated runway bodies that in the future could mean bearing capacity problems?

Jenny Ryman
Strategic Investigator, Civil Aviation and Maritime Department, Swedish Transport Agency

> Extreme precipitation is the primary climate factor that airports report as a larger risk in the future compared to today.

Jenny Ryman has over 15 years of experience working on climate change adaptation and is currently the coordinator of climate change adaptation for all transport modes at the Swedish Transport Agency. She has a Master of Science in environmental engineering from Luleå University of Technology and started working as an environmental expert in civil aviation at the Swedish CAA in 2005.

The responses from airports and heliports indicate that no major changes are currently observed as a result of a changing climate. Airports are typically constructed to withstand challenging weather conditions, and none reported observing any reduction in accessibility to the airports. Several airports participate in the municipality's or county board's work on risk and vulnerability analyses, and many have implemented systematic procedures where climate-related risks are documented, for example in risk assessments.

Extreme precipitation is the primary climate factor that airports report as a larger risk in the future compared to today. In 2021, there were a few instances of significant precipitation occurring within a short period, but the airports affected managed to remain open. Snowfall has occasionally forced airports to close down during winter. Airports located near regulated rivers could face growing challenges in a future with more heavy rainfall if water needs to be released from the hydropower stations, potentially leading to river flooding, causing both erosion and inundations.

Swedavia AB, responsible for the state-owned aerodromes, has mapped risks related to climate change and has developed action plans for several areas. Swedavia has also assessed the impact that extreme precipitation would have on several airports. There is an ongoing review of the need for adaptation in facilities to handle increased rainfall and other climate-related challenges, and critical equipment in flood risk locations has been identified. Additionally, a new storm water guideline has also been developed. Procedures are in place to prevent climate-related disturbances and interruptions that could lead to safety consequences.

In some cases, it is mentioned that a future rise in groundwater levels could pose problems, and enlarging the drainage systems may be necessary. Work has also been conducted at airports to clear drain wells and ditches in order to prepare for heavy rains. Several airports have reported that future weather conditions are factors taken into consideration when work is being conducted on the drainage system.

The Swedish Transport Agency will continue to raise awareness among stakeholders and within the authority, identifying how climate change adaptation, as a complement to reducing climate emissions, can be incorporated into everyday work. This includes providing practical examples of how the civil aviation system has been affected by specific extreme weather events and how we can learn from these experiences to better estimate the consequences for actual operations on a systematic scale. ●

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My beach retreat in Norway: how climate change can reshuffle Europe's tourism demand

Extreme heat and the proliferation of adverse weather events can change the physiognomy of the European tourism industry, greatly affecting traditional summer vacation spots.

The tourism industry, a significant contributor to European gross domestic product and total employment, may face considerable stress due to climate change. In a recent study, we examined the potential impact that climate change can have on the European tourism sector. Using data from 1311 regions over a 30-year (1991-2019) monthly timeframe, we estimated the effect of climate conditions on tourism demand. We rated climate using the Tourism Climatic Index (TCI), a synthetic indicator that accounts for several weather variables (temperature, humidity, precipitation, radiation, wind) contributing to making the tourist experience more or less pleasant. Simultaneously, we also controlled for several other factors that can affect tourism demand, such as the presence of seasonal effects and the types of tourism services demanded. Our identification mechanism relied on the premise that the relative importance of climatic conditions is likely to differ when measuring, for example, the demand for coastal tourism, urban tourism, or recreational activities in natural environments, and that the demand for specific types of tourism varies depending on the time of year.

> In coastal areas, the sensitivity of tourism to climate is twice that observed in other regions.

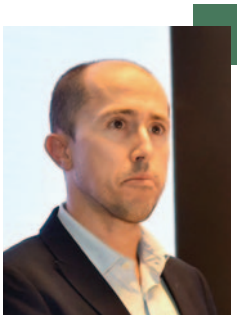
The role of climate in tourism demand

Our findings reveal that climate conditions significantly affect tourism demand, with coastal regions being the most impacted areas. Taking into account seasonality, geographical patterns, and regional typologies such as coastal and urban areas, the analysis shows that a 1% decrease in the TCI (approximately denoting a 1% decrease in the climate conditions suitable for tourism activities) is associated on average with a 0.57% decrease in the monthly regional occupancy. However, the magnitude of the impact varies depending on the specific tourism typology considered. For example, in coastal areas the demand was found to be very elastic to climate, with an expected decrease of 1.22% per additional unit of TCI lost, more than double the sensitivity estimated for types of tourism.

We then simulated the impacts of future climate change on tourism demand for four warming levels: +1.5°C, +2°C, +3°C, and +4°C. According to our projections, the overall impact on European tourism demand is expected to be positive across all warming levels, with a projected rise of 0.35% under moderate warming (+1.5°C), and up to 1.58% for the highest warming scenario (+4°C). However, we also identified a great deal of spatial heterogeneity in the estimated impacts, indicating the presence of significant winners and losers. We found a clear north-south pattern in tourism demand changes, with northern regions benefitting from climate change and southern regions facing significant reductions in tourism demand, an effect that is further intensified with more warming.

Climate effects on tourism seasonality

The projected shift on the tourism patterns will not only be spatial but also temporal. A generalised worsening of climate conditions is expected in southern Europe during summer months. This will lead to a pronounced decline in the demand for tourism in traditional seaside vacation spots. Tourists will avoid the scorching heat in southern coastal regions during the summer and will migrate to more temperate areas, particularly under +3°C and +4°C warming scenarios. A temperature rise of 3°C or 4°C will reduce the number of summer tourists by almost 10% in southern coastal regions and raise demand for northern coasts by 30%, representing a significant tourist drain in the south, several orders of magnitude larger than the expected



David García-León
Scientific Officer, Joint Research Centre – European Commission

> Although market impacts will be substantial, there is ample room for adaptation.

increase in the north. Under higher warming scenarios, the decline in summer demand in southern regions will be partially offset by higher tourist arrivals during the shoulder seasons (spring and autumn). However, this increase will be insufficient to fully mitigate the demand fall observed during the peak season.

Conclusion

Our findings indicate a future where tourism patterns will undergo radical changes. A significant spatial and temporal reshuffle in the demand for tourism is projected due to the influence of climate change. These changes will have profound socio-economic impacts across Europe, particularly in regions traditionally known for being popular summer vacation destinations, which are heavily dependent on tourism as a major economic driver.

The above results provide valuable insights, serving as a warning to all stakeholders involved about the high likelihood of substantial disruptions in the market for tourism services. However, it is essential to interpret the magnitude of these results with caution due to two main reasons: (i) total impacts are based on simplifying, often strict, market assumptions, and (ii) there is considerable room for adaptation. In our assessment, we assume full flexibility in how demand is reallocated in response to climate. Tourists can freely decide where and when to travel with no frictions and at no cost, and the tourist industry is able to ingest the shifts in the demand instantaneously. Nevertheless, a more realistic approach would acknowledge the presence of market inertia, capacity thresholds, and other constraints, which could mitigate the total impact observed. Additionally, various adaptation practices can be implemented in threatened areas to retain tourists. Finally, the proliferation of more frequent and more intense extreme weather events, such as heatwaves and wildfires, can also have disruptive effects in the market. Exploring these counterfactual scenarios constitutes an avenue for future research.

To maintain Europe's status as a leading tourist destination, the European Commission launched in 2022 a roadmap to achieve a twin transition (green and digital) and promote resilience in tourism. In addition, the European Agenda for Tourism 2030 emphasises the need to protect the tourism sector while developing a forward-looking vision to capitalise on the willingness of many Europeans to change their travel and tourism habits to become more sustainable and responsible.

Developing sustainable tourism requires local and regional planners to consider the impact of climate change and the surrounding natural environment when developing destinations. Climate mitigation and adaptation measures should always be integrated into smart and sustainable tourism strategies at national, regional, and local levels. However, as temperatures rise and weather patterns become more unpredictable, more urgent and intense action to achieve tourism sustainability is needed. ●

David García-León
is a scientific officer at the Joint Research Centre of the European Commission. In this role, he contributes to the economic analysis of climate risks in Europe from both aggregate and regional perspectives, assessing cross-sectoral impacts and the effectiveness of alternative adaptation policies. His areas of expertise include water scarcity, labour productivity, occupational and human health, as well as tourism.

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Bolstering adaptation and increasing resilience of the United States' air transportation system

Bold action to tackle the climate crisis is more urgent than ever, and the United States is doing its part to build a net-zero emission, resilient future. President Biden's Executive Order 14057 on catalysing American clean energy industries and jobs through federal sustainability, and the accompanying Federal Sustainability Plan, outlines an ambitious path to prepare federal agency policy, programmes, operations, and infrastructure to adopt adaptive and resilient strategies to mitigate for potential future climate impacts. The United States Federal Aviation Administration is taking action to bolster adaptation and increase resilience.

Introduction

Addressing the climate crisis through enhanced ambition is a defining priority of our time, and the United States is doing its part to build a net-zero-emission, resilient future. To put action to this ambition, the Federal Aviation Administration (FAA) published the *United States Aviation Climate Action Plan* in 2021, which describes a whole-of-government approach to put the US aviation sector on a path towards achieving net-zero emissions by 2050. This plan builds on individual and sector-wide commitments announced by the United States aviation industry and highlights specific actions and policy measures to foster innovation and drive change across the entire US aviation sector.

As part of this plan, the FAA is ensuring a "climate-ready" US aviation sector by addressing sustainability and resilience throughout its broad range of programmes and activities. The United States has a wide variety of climates and, as a result, different impacts from climate change that require varying adaptation strategies. This presents the nation, and the FAA, with a particularly complex challenge given its broad range of programmes and activities.

The FAA is the civil aviation authority (CAA) and primary air navigation services provider (ANSP) in the United States. In this role, FAA oversees the safety of civil aviation and manages the National Airspace System (NAS). The NAS includes a network of air traffic management facilities, flight service stations, and extensive technical infrastructure, including communications, navigation, and surveillance systems. Through this network, the FAA provides air traffic control and other air navigation services to support a safe and efficient aviation system. The FAA is also responsible for national airport planning and programmes related to airport safety and inspections, and standards for airport design, construction, and operation.

The FAA is working to ensure a "climate-ready" aviation sector and these efforts include: 1) resiliency of airports, 2) operations of aircraft, and 3) bolstered air traffic infrastructure to eliminate or reduce the impacts of extreme weather.

Guidance and support to airports

Tidal flooding, permafrost collapse, rising sea levels, and more severe storms threaten an increasing number of airports throughout the United States. According to the US government's 2017 National Climate Assessment, 13 of the US's 47 largest airports have at least one runway that may be impacted by a moderate or high storm surge, and this impact is only expected to rise with the increased frequency of extreme weather events. Some smaller – but critical – airports, such as those used by remote Alaskan villages, have had entire runways rebuilt due to permanent inundation.

The FAA's Office of Airports is working with airports across the nation to develop a framework through which research will help identify and prioritise vulnerable airports and assist in the development

Mitchell Otey
Environmental Protection Specialist, United States Federal Aviation Administration, Office of Environment & Energy

> "Addressing the climate crisis through enhanced ambition is a defining priority of our time, and the United States is doing its part to build a net-zero-emission, resilient future."

Flooding at an airport in Galveston, TX following Hurricane Ike (2008)

of tools to integrate into airport planning documents. To date, case studies have been completed at several large airports including Philadelphia International Airport, Seattle-Tacoma International Airport, and San Diego International Airport. Critical assets were analysed and vulnerabilities, along with mitigation strategies, were identified to inform both FAA decision-making and airport management. The FAA's Office of Airports also leads the *Energy Supply, Redundancy, and Microgrids Program* that provides funding to airports to improve the reliability and efficiency of power supply including backup, emergency power that will be more critical as weather events increase.

In addition, the FAA's William J. Hughes Technical Center, located in Atlantic City, New Jersey, is conducting groundbreaking research to help airports make innovative, cost effective, climate-ready improvements. The Center is currently working with domestic and international partners to evaluate sustainable asphalt, made from recyclable content, and comparing this "green" alternative to legacy conventional materials. This study could provide airports with a more nimble, efficient, and resilient approach to maintaining runways.

"13 of the US's 47 largest airports have at least one runway that may be impacted by a moderate or high storm surge."

Aircraft operations

Many aircraft systems are limited by ambient temperatures during certain phases of flight and may be impacted as these temperatures change over time. The FAA's Flight Standards Service organisation requires operators to follow Airplane Flight Manual (AFM) limitations, performance limitations, and operating rules to ensure they operate safely in the NAS in all planned and forecasted conditions. These requirements already account for, and enable airlines to adapt to, the impact of climate change on aircraft performance. Operators ensure that their aircraft is capable of safely departing by following the FAA-approved AFM. In some cases, operators will need to reduce aircraft weight to safely take off, which can be accomplished by reducing fuel load, cargo, and/or passengers. In other cases, operators may adapt flight schedules to operate in conditions (e.g. times of day when airport surface temperatures are lower) where required aircraft performance can be met.

The FAA is also continuing to invest in trajectory-based air traffic management tools to improve gate-to-gate operational performance. Through collaboration with domestic and international aviation stakeholders, the FAA is transitioning the NAS to trajectory-based operations, which optimises flights and delivers opportunities to reduce noise, fuel, and emissions. These efforts not only help airlines adapt to weather conditions but may reduce the aviation sector's contribution to climate change by reducing fuel consumption.

Bolster air traffic infrastructure

In the United States, air traffic infrastructure faces significant impacts from extreme weather events including heat domes, hurricanes, and large-scale wildfires, all of which can cause severe damage and cripple domestic and international operations. Historically, the NAS, with approximately 12 500 facilities, buildings, and navigational aids, has been an incredibly resilient system with redundancies and mitigation tactics built into nearly every piece of equipment. While this remains true, climate change may produce an additional layer of challenges that require an increase in vulnerability assessments and infrastructure improvements. For example, in 2022, Congress appropriated $100 million in additional funding to the FAA following Hurricane Ida. This funding allowed the FAA to repair or replace damaged facilities along the storm's path while making improvements to ensure similar impacts are avoided in the future.

The FAA is now going further and taking an even more proactive approach to improving resiliency. On 27 January 2021, President Biden signed Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad", which directed all federal agencies to conduct vulnerability assessments on mission-critical facilities and take action to prepare for the impacts of climate change. As such, the FAA worked with the US Department of Transportation's Volpe Center to develop an analysis to rapidly, but thoroughly, produce vulnerability assessments and prioritise mitigation tactics on almost 700 mission-critical FAA facilities.

Conclusion

Addressing climate change is a global challenge requiring many strategies, stakeholder participation, and diverse subject-matter expertise and leadership. The FAA is collaborating internationally and taking action domestically to help develop and implement robust "climate-ready" initiatives across the US aviation sector by bolstering sustainability and resilience throughout the FAA's broad range of programmes and activities. ●

Mitchell Otey is an environmental protection specialist at the Federal Aviation Administration. He works in the Office of Environment and Energy and assists the agency with meeting numerous sustainability and environmental management goals. He also has a background in managing environmental remediation and renewable energy installation projects.

Asphalt testing equipment at the FAA's William J. Hughes Technical Center in Atlantic City, NJ

Taking action:
practical steps towards adaptation

Navigating climate challenges: prioritising adaptation in aviation

In an era marked by increasing climate variability and extreme weather events, the aviation industry faces unprecedented challenges. Disruptions in the aviation network can have cascading effects, impacting global trade and connectivity. States and organisations are increasingly recognising the potential risks posed by climate change, necessitating the integration of these risks into their future planning and adaptation strategies.

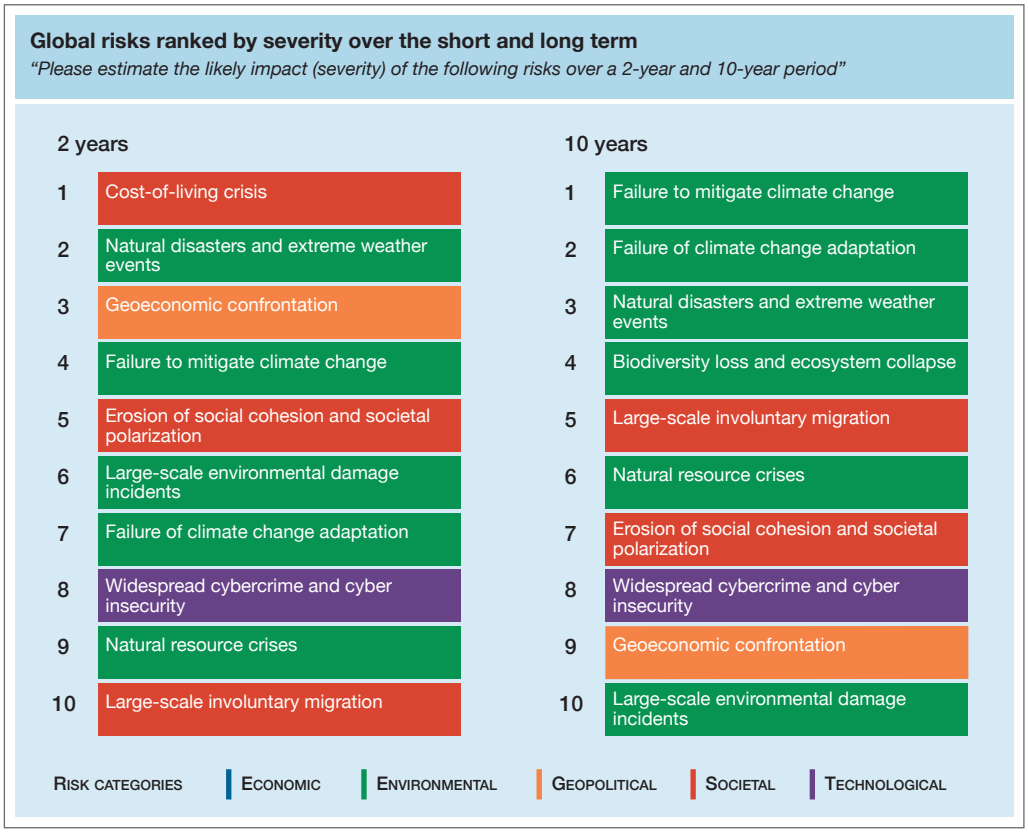
The urgency and significance of adapting to the evolving climate are increasingly apparent as it impacts all stakeholders. Emphasising this importance, the *Global Risks Report 2023* published by the World Economic Forum (WEF) highlights that climate and environmental risks will take centre stage in global risk perception over the next decade. The illustration below from the report, depicting the top ten risks over the short and long term, clearly indicates that climate change adaptation will rank as the second most crucial risk in the next ten years.

In addition to that, the Intergovernmental Panel on Climate Change (IPCC) *Sixth Assessment Report (AR6) Working Group II Climate Change 2022: Impacts, Adaptation and Vulnerability* emphasises the critical importance of adaptation and resilience. It highlights the urgent need for developing climate-resilient strategies on a global scale. The findings of this significant scientific work not only inspire but also guide the efforts of ICAO in the field of adaptation and resilience, closely aligning with the key points of the report.

The aviation industry, in particular, stands at the forefront of climate adaptation efforts. With its integrated network of airlines, airports, and air traffic management systems, the sector is uniquely susceptible to the impacts of climate change. From extreme weather events disrupting flight schedules to rising sea levels threatening coastal airports, the aviation industry faces a multitude of obstacles. However, among these challenges lies an opportunity for innovation and resilience-building. Aviation also has an important role in providing initial response during extreme weather events. Aircraft, including helicopters, planes, and drones, are instrumental in swiftly reaching disaster-impacted areas and providing necessary assistance. They are particularly invaluable in regions where ground transportation is difficult or completely disrupted. For instance, in emergencies such as earthquakes, floods, or wildfires, aerial support can facilitate the arrival of aid teams even when roads are damaged or impassable. The flexibility and speed of aviation can expedite and enhance the initial response process during natural disasters, thus aiding in minimising loss of life and property damage. This, of course, in addition to the very important role aviation plays in collecting climate-related data paramount to climate adaptation-related studies and assessments.

Jane Hupe
Deputy Director, Environment, International Civil Aviation Organization

Global risks ranked by severity over the short and long term
"Please estimate the likely impact (severity) of the following risks over a 2-year and 10-year period"



Source: World Economic Forum Global Risks Perception Survey 2022-2023

ICAO *Climate Risk Assessment, Adaptation and Resilience* report

Notwithstanding the extent of such social and environmental aspects of adaptation for aviation, the economic ones are also extremely important factors to consider. For example, in 2022, post-tropical storm Fiona hit Sydney Airport, damaging the facade of the terminal building, battering an airport hangar, and necessitating the cancellation of numerous flights. Officials estimated that the damage caused by this extreme weather event would cost approximately $2 million, as announced in a statement.

Acknowledging the urgency and significance of the matter, the International Civil Aviation Organization (ICAO) has adopted a multifaceted strategy for climate resilience. This strategy integrates both climate mitigation and adaptation measures. Over the past decade, ICAO has actively disseminated best practices and guidance material to States and aviation stakeholders, aligning with scientific knowledge.

The initial work undertaken by ICAO involved synthesising available information to gain a comprehensive understanding of the potential climate impacts on the aviation sector, where a comprehensive survey was circulated among Member States to identify effects that are already being experienced and that may relate to climate change, on a local, regional, and global level. All information and responses collected are reported in the *2018 Climate Adaptation Synthesis* report [1].

Key findings from the *2018 Climate Adaptation Synthesis* report underscore the urgency of climate change concerns, revealing that 74% of respondents reported first-hand experience of climate change impacts, with none anticipating escape from these impacts. Furthermore, the report identified the following top climate change effect categories anticipated/experienced by respondents:

- higher average and extreme temperatures;
- changing precipitation patterns;
- increased intensity of storms; and
- sea level rise.

The report's findings provide a clear indication that global temperatures and climate impacts and risks are continuing to rise, echoing the concerns of people worldwide and underscoring the urgent need for rapid acceleration of global adaptation action.

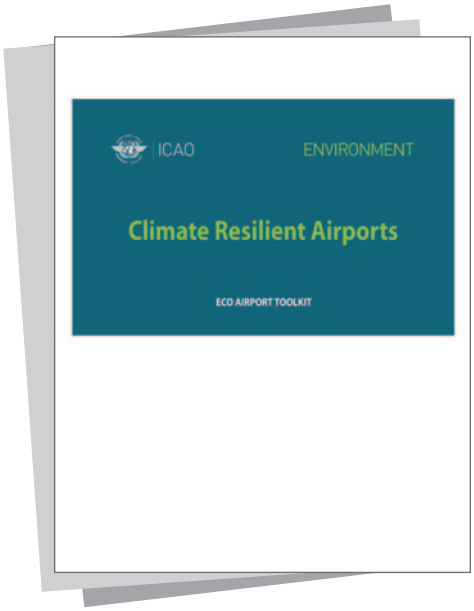
Furthermore, ICAO is currently working on an updated edition of the *Climate Adaptation Synthesis* report, with the initial results highlighting growing concerns and impacts within the aviation community, clearly indicating the relevance of the issue. This is also apparent in the nearly threefold increase in participating stakeholders responding to the new survey, as well as in their overall responses to the survey questions. The updated *Climate Adaptation Synthesis* report, which aligns with the most recent scientific findings and includes a detailed analysis of the survey responses, will be released in 2025. This report will shed light on the changes in aviation stakeholder concerns over time.

In 2022, ICAO completed a comprehensive information-gathering process that culminated in the publication of the *Climate Risk Assessment, Adaptation and Resilience* report [2]. This report aims to support States in performing a climate change risk assessment and in developing and implementing a climate change adaptation plan. It identifies key climate change vulnerabilities that a State or organisation may face, and provides a menu of potential adaptation options for States and organisations to consider.

(1) Available at: https://www.icao.int/environmental-protection/Pages/Climate-Adaptation.aspx
(2) Available at: https://www.icao.int/environmental-protection/Pages/Climate-Change-Climate-Risk-Assessment,-Adaptation-and-Resilience.aspx

Collaborative efforts involving governments, industry stakeholders, and international organisations will be essential in shaping a climate-resilient aviation future. In light of the particular challenges that sand and dust storms present to aviation safety, airport infrastructure, and the smooth functioning of overall operations, ICAO's membership in the United Nations Sand and Dust Storm (SDS) Coalition denotes its ongoing collaboration with other UN entities to expand knowledge and expertise in this area, enabling States to collectively address these urgent challenges.

In some parts of the world, such storms are already occurring more frequently and posing risks to aviation operations and infrastructure. However, solutions to mitigate these challenges do exist. The United Nations Environment Programme (UNEP) *Adaptation Gap Report 2023* provides an excellent case study of how ecosystem-based adaptation approaches can help reverse negative feedback cycles, such as those associated with sand and dust storms. The report highlights that practices such as local shrub and tree planting, protection against overgrazing, and restoration of wetlands in the Middle East region offer hope in providing local and regional environmental benefits and enhancing trust among communities and across borders. This underscores the importance of global solidarity and collaboration.



Additionally, real-world examples of several other climate hazards showcase how airports and other aviation stakeholders are translating climate resilience into action. The ICAO Eco-Airport Toolkit e-collection [3], a series of online publications, serves as a comprehensive resource in that regard. It offers insights into the climate-related challenges airports may face, along with proactive strategies for anticipation and preparation. As an example, the e-publication on *Climate Resilient Airports* provides a high-level overview of the issues climate change may bring for airports, as well as some strategies on how to anticipate and prepare for contingencies with concrete examples of action.

In conclusion, through collaborative efforts with governments, industry stakeholders and international organisations, ICAO is committed to prioritising the development, sharing and implementation of climate resilience strategies while recognising the urgent need for adaptation measures to address the growing impacts of climate change on the aviation industry.

This commitment is reflected in ICAO publications that aim to support States in identifying vulnerabilities and implementing climate adaptation plans. Additionally, ICAO's involvement in transboundary cooperation, such as its membership in the United Nations Sand and Dust Storm Coalition, demonstrates its commitment to global solidarity and collaboration in addressing climate-related challenges. As the aviation sector faces increasing climate variability and extreme weather events, ICAO's leadership underscores the importance of prioritising adaptation efforts to ensure a sustainable and resilient aviation future. ●

Jane Hupe is the deputy director responsible for the environment programme at ICAO, and serves as the secretary of the Committee on Aviation Environmental Protection (CAEP). Jane has a vital role in providing leadership for ICAO's efforts to define and promote policies and standards for sustainable aviation, managing a portfolio that includes aircraft noise, local air quality, global climate, clean energy and sustainable aviation fuels, adaptation, circular economy and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), the global market-based measure for international aviation. She currently leads ICAO's efforts on green innovation for mitigation and adaptation. Under her leadership, ICAO adopted the long-term aspirational goal of net-zero aviation CO_2 emissions by 2050 and is developing the implementation framework for its achievement, together with capacity building and assistance framework.

(3) Available at: https://www.icao.int/environmental-protection/pages/ecoairports.aspx

Adapting the European aviation sector to a changing climate

According to the United Nations Intergovernmental Panel on Climate Change (IPCC) *Sixth Assessment Report*, climate change is happening faster than previously projected, and the impacts will be more extreme. Projected effects include more frequent and more intense storms, rising sea levels, and higher average and extreme temperatures. This will have a disruptive impact for all sectors of society, including the European and global aviation sector, bringing potential risks to aviation infrastructure and disruption to operations, as well as safety, economic and societal impacts. For example, stronger storms might disrupt operations both at airports and en route; airport capacity might be lost due to flooding; or extreme high temperatures might cause health impacts for employees and personnel.

Rachel Burbidge
Senior Policy Officer, Environment and Climate Change, EUROCONTROL

But this is just an indication of the potential impacts. More information can be found in resources such as the EUROCONTROL *Climate Change Risks for European Aviation* report, or the ICAO *Climate Adaptation Synthesis* report. EUROCONTROL is working with its partners to best support the entire sector in adapting to these pressing impacts of climate change and becoming more resilient. The work here forms one pillar of our sustainability initiative, FlyingGreen, described in EUROCONTROL's Raising the Aviation Bar programme.

The specific impacts that an organisation may face will vary greatly depending on factors such as the type of organisation (for example airport, airline, or air navigation service provider), geographical factors such as proximity to sea level, and how the climate is projected to change in the region. To understand specific risks and vulnerabilities, an organisation is usually recommended to carry out a climate change risk assessment. Once potential impacts are identified, the organisation can develop a climate adaptation plan and start to identify and implement suitable adaptation measures, taking account of resource availability and business priorities.

> "EUROCONTROL is working with its partners to best support the entire sector in adapting to these pressing impacts of climate change and becoming more resilient."

At global level, EUROCONTROL, together with the United States Federal Aviation Administration, co-led work by ICAO to develop guidance on *Aviation Organisation Climate Change Risk Assessment and Adaptation Planning*. Within Europe, EUROCONTROL and ACI EUROPE co-chair the European Aviation Climate Change Adaptation Working Group. The group currently has 38 member organisations including airport operators, air navigation service providers, aircraft operators, European aviation industry associations, and aircraft manufacturers. The objective of the working group is to provide aviation stakeholders with guidance, peer support and good practices on adapting the European aviation sector to the impacts of climate change. The group's first deliverables, *Aviation Preparations for Summer Adverse Weather* and *Aviation Preparations for Winter Adverse Weather*, provide tangible recommendations for European aviation organisations to prepare for the possibility of both extreme summer and winter weather events. The

group is now beginning work on awareness-raising material to promote climate adaptation among European aviation stakeholders and regionally focused guidance material to support them in taking action.

EUROCONTROL's #FlyingGreen platform of services will include a set of services called ClimAdapt. ClimAdapt is a toolkit consisting of tailored guidance, a repository of information on climate change impacts and adaptation measures, and a screening tool to provide a high-level assessment to support stakeholders in decision-making regarding whether they should perform a climate change risk assessment. The tool will identify key climate effects in the user's region and ask a series of questions to determine whether a detailed climate risk assessment is required. The output can be used to inform senior management. The platform will also provide a climate impact cost estimate analysis tool to support decision making. Development and consultation with stakeholders are ongoing and we expect to have first outputs by summer 2024.

It is clear that awareness of the physical climate impacts the sector is likely to face, and in some cases are already experiencing, is growing and European stakeholders are starting to take action. But more needs to be done to make sure we are as resilient as possible to future impacts. However, action is increasing and collaborative efforts are growing. By working together as a sector we can take the necessary action today to prepare for the climate impacts of tomorrow. ●

EUROCONTROL is developing a set of services called ClimAdapt, a toolkit with guidance and information on climate change impacts and adaptation measures.

Rachel Burbidge
senior policy officer on environment and climate change, joined EUROCONTROL in 2005. She has been leading EUROCONTROL's work on climate change adaptation and resilience since 2009, authoring the organisation's ground-breaking challenges of growth work on climate adaptation, and several peer-reviewed journal articles. She co-leads the climate adaptation and resilience work of the ICAO Committee on Aviation Environmental Protection (CAEP) Airport and Operations Working Group, and leads EUROCONTROL's contribution to the ICAO CAEP Working Group on CORSIA, where she leads tasks on monitoring, reporting and verification. She has degrees in environmental studies and sustainable development.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EASA takes the lead on adapting aviation to climate change

Luc Tytgat
High Representative of the Executive Director, European Union Aviation Safety Agency (EASA)

Adaptation to climate change is an EU strategic priority

The *Sixth Assessment Report* [1] of the Intergovernmental Panel on Climate Change (IPCC) explains that every incremental increase of the global mean air surface temperature magnifies the impacts of severe weather events, such as storms and hurricanes, heatwaves, heavy precipitations, flooding, droughts, etc. This can manifest itself in numerous ways, including:

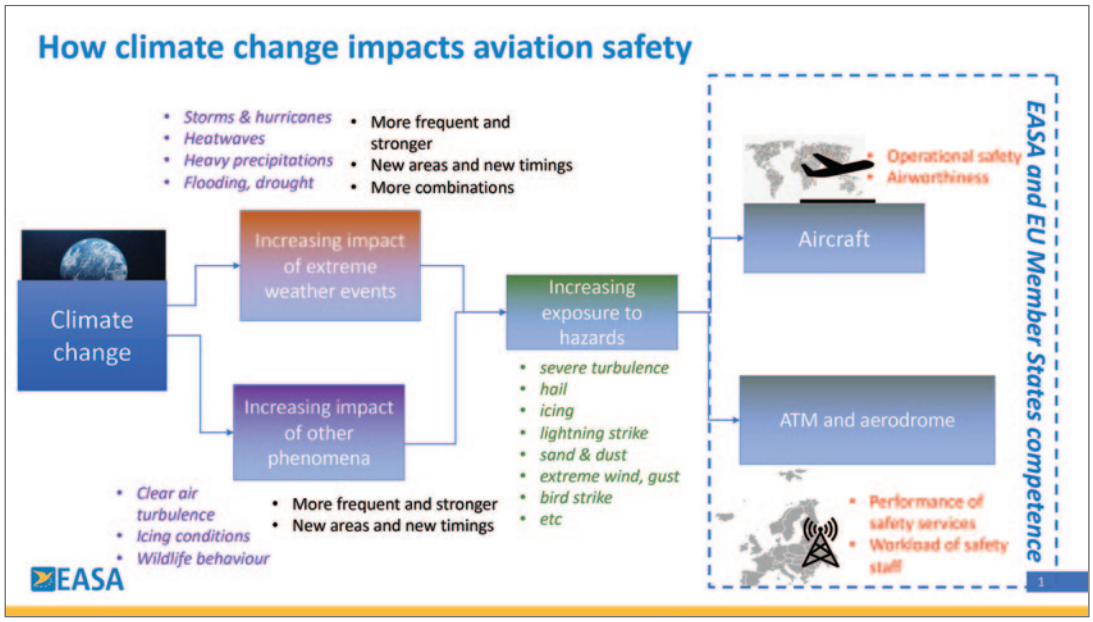
1 | Increased magnitude and/or frequency of the severe weather events.
2 | Severe weather events occurring in new regions.
3 | Severe weather events occurring either earlier or later in the year than they have in the past.
4 | More frequent combinations of severe weather events.

This is why adapting to climate change has become a strategic priority for the EU. The European Commission adopted an "EU Strategy on Adaptation to Climate Change" [2] in 2021, which is supported by the European Parliament and the Council. This strategy addresses the need to improve the existing knowledge and the management of the uncertainties associated with climate change, and it foresees the development of policy in all sectors. In addition, Article 5 of the European Climate Law [3] requires Union institutions and the Member States *"to ensure continuous progress in enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change".*

How is climate change affecting aviation?

Severe weather events are sources of hazards [4]. These hazards may affect the airworthiness of an aircraft, the workload of front-line staff (flight crew, ATC officers, aerodrome operational staff), or the performance of air traffic management and air navigation services (ATM/ANS) and aerodrome safety services. Examples of such hazards include severe hail encounter, lightning strike, dust, runway contamination, low-level wind shear, etc. The increasing impact of severe weather events caused by climate change also means an increasing exposure of aviation to weather hazards.

(1) Assessment Report 6 (*Climate Change 2021: The Physical Science Basis*), August 2021.
(2) A new EU Strategy on Adaptation to Climate Change (europa.eu)
(3) Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021, establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (European Climate Law).
(4) "Hazard" designates a condition or an object with the potential to cause or contribute to an aircraft incident or accident (source: ICAO Doc 9859, *Safety Management Manual*).



In addition, several research works indicate that some weather hazards not necessarily associated with severe weather events (clear air turbulence [5], airborne icing) may also be magnified by climate change.

Given that the typical lifetime of aeroplanes, ATM/ANS ground equipment and airport infrastructure is of several decades, they may become more and more exposed to unforeseen conditions, leading to reduced reliability, availability or performance. This could ultimately result in costly corrective measures (e.g. mandatory retrofit, significant operational restrictions) to maintain adequate levels of safety.

EASA actions

In 2021, EASA reviewed what was known regarding the effects of climate change on aviation, and the initiatives led by other organisations. It was found that:

- adequate scientific knowledge to assess safety risks caused by climate change was often not accessible to aviation stakeholders. Publicly available information on weather hazard trends was very high-level; and
- there was no Europe-wide activity including scientists and aviation stakeholders to assess the impact of climate change on aviation safety. There were some national initiatives, and a few international working groups but these were not bringing together climate science and industry experience or analysing the safety effects of climate change.

> “The increasing impact of severe weather events caused by climate change means an increasing exposure of aviation to weather hazards.”

Based on this observation, EASA decided:

1 | to focus future work on gathering more knowledge and data on the impact of climate change on safety; and

2 | to acknowledge the importance of climate change adaptation through a strategic priority in the European Plan for Aviation Safety.

Gathering advanced scientific knowledge on the effects of climate change on aviation

To address the first action defined in 2021, a task force was set up under the aegis of EASA’s Scientific Committee, with an objective to review the scientific publications on weather hazard trends caused by climate change.

This task force initially focused on trends regarding severe convective storms, and trends regarding clear air turbulence. Their first findings can be consulted in the Annual Report 2022 of EASA’s Scientific Committee [6].

In 2023, they extended the scope of their review to trends regarding airborne icing, dust storms and sandstorms, and surface temperatures. The new findings will appear in the Annual Report 2023 of EASA’s Scientific Committee.

An EPAS priority and a work programme

An objective “Managing the impact of climate change” has been recently added to the strategic priorities stated in the EPAS [7] Volume I (Strategic Priorities). In addition, a new action RES.0059

(5) Turbulence occurring in cloudless regions. It is not detectable with a conventional radar, so that it typically occurs without warning.
(6) This report can be consulted on the webpage of EASA’s Scientific Committee: EASA Scientific Committee (SciComm) | EASA (europa.eu)
(7) All EPAS volumes can be found at *European Plan for Aviation Safety* | EASA (europa.eu)

To tackle the safety effects of climate change on aviation safety, EASA has established an EU-wide strategy and a work programme.

As high representative of the executive director, **Luc Tytgat** supports the EASA executive director, offering strategic advice and representing EASA at high-level events. Prior to this, Luc spent seven months as acting executive director of EASA. Luc joined EASA in January 2015 as its strategy and safety management director. He had been director of the Pan-European Single Sky Directorate at EUROCONTROL from 2011, having previously worked for 20 years in the field of air transport and space at the European Commission, and ten years in the Belgian Air Force. Luc graduated from the Belgian Military Academy as an engineer in aeronautics and also holds a master's in public management from Solvay Business School in Brussels.

Guillaume Aigoin, a senior flight data expert in the Strategy and Safety Management Directorate of EASA, is coordinating EASA climate change adaptation activities.

"Impact of climate change on commercial air transport with aeroplanes – review of scientific works", was inserted in the EPAS Volume II (EPAS Actions). Finally, EPAS Volume III (Safety Risk Portfolios) highlights the EU-wide aviation safety issues that are potentially affected by climate change.

EASA has also established a dedicated work programme that is managed by a team of experts across directorates.

A European network to address the impact of climate change on aviation

In November 2023, EASA launched the European Network on Impact of Climate Change on Aviation (EN-ICCA), an expert network with the aviation industry, national aviation authorities, research organisations and national meteorological services.

The objectives of the EN-ICCA are:

- to provide aviation stakeholders with a better, science-based understanding of the effects of climate change on safety and to identify corrective actions;
- to inform the scientific community of the priority research topics for the aviation stakeholders regarding the impact of climate change; and
- to help EASA and other authorities to manage the effect of climate change on aviation.

In practice, the EN-ICCA will assess weather hazard trends and their effect on the aviation safety domains, and produce recommendations to close knowledge gaps. In addition, it plans to assess the safety effectiveness of climate change adaptation measures. Coordination with other initiatives, such as the European Aviation Climate Change Adaptation Working Group (EACCA WG) led by EUROCONTROL and ACI, will also be ensured.

First results of the EN-ICCA are expected toward the end of 2024.

Conclusion

To tackle the safety effects of climate change on aviation safety, EASA has established an EU-wide strategy and a work programme. They are implemented through intense collaboration with researchers and aviation stakeholders. ●

Attendees at the inaugural meeting of the European Network on Impact of Climate Change on Aviation (EN-ICCA) at the EASA headquarters in Cologne on 9-10 November 2023

News from ECAC and JAA TO:

- ECAC Spotlight
- ECAC in brief
- JAA TO

Air Accident and Incident Investigation Group of Experts

interview with

Crispin Orr
Chair of the ECAC Air Accident and Incident Investigation Group of Experts

WHAT IS THE AIR ACCIDENT AND INCIDENT INVESTIGATION GROUP OF EXPERTS (ACC)?

The ACC group was formed in 1992 and is one of the key working groups in ECAC. Its membership consists of the heads of the safety investigation authorities (SIAs) from the 44 ECAC Member States, together with observers from other regions of the world. In addition, the group includes representatives from key international organisations (such as EASA, EUROCONTROL and ICAO), industry associations such as IATA, aircraft and engine manufacturers, operators and airports. The continuous dialogue and exchange of experience with industry stakeholders is one of the main strengths of the ACC group.

WHAT ARE THE GROUP'S MAIN OBJECTIVES?

The first is to enhance the effectiveness of Member States' safety investigation capabilities. Accident and incident investigation is a complex business, and we face many operational and technical challenges as we conduct our investigations. The ACC group meets twice a year to share knowledge, ideas and experience. In addition, we organise a workshop every two years to look more deeply at a topic of common interest.

Secondly, we promote the European experience and know-how in safety investigations across the wider international aviation community through outreach to other regional groups, and participation in ICAO expert panels and events.

Thirdly – and perhaps most importantly – we contribute to the improvement of aviation safety by sharing information and lessons learnt from accident and incident investigations across the aviation community. For example, each year we compile a database of all the investigations completed by ECAC safety investigation authorities, highlighting the key risk areas, the safety action taken, and safety recommendations made. We then share these details, together with links to all the final reports, with Member States, international organisations and industry stakeholders.

WHAT TOPICS OR PROJECTS IS THE GROUP CURRENTLY FOCUSING ON?

Fortunately, accidents involving commercial air transport in Europe are very rare. But there are quite a lot of incidents where safety is compromised to some extent, and some serious incidents where there is a high risk of an accident. It is very important that these "near misses" are investigated thoroughly to identify the safety issues so that corrective action can be taken to prevent them causing an accident in the future. ACC held a workshop in 2023 involving 75 experts to look in detail at this topic, including how to identify the serious incidents that warrant an in-depth investigation. The workshop yielded many insights that have been distilled into a guidance note on the investigation of serious incidents that is proposed for adoption by all ECAC Member States.

Our next meeting will be in May in Stavanger – an important base for onshore and offshore helicopter operations. We are therefore preparing an agenda that will focus on helicopter safety and the investigation of helicopter accidents and serious incidents.

LOOKING FORWARD, WHAT CHALLENGES DO YOU SEE EMERGING FOR THE ACC GROUP?

It seems that global warming is having an increasing impact on aviation. There are more severe weather events, and these can introduce hazards such as severe turbulence, windshear and icing, reduced visibility, contaminated runways and so on. Severe weather can also lead to operational difficulties such as congestion, leading to aircraft getting unduly close to their fuel minima. Our investigations can help the industry to learn from these challenging events.

The drive to reduce carbon emissions has been a catalyst for the introduction of sustainable aviation fuel and innovation to develop new forms of energy storage and propulsion. There are many new genres of manned and unmanned aircraft under development, and it is not surprising that, in the race to bring new technologies to market, accidents will happen. So the ACC group is monitoring devel-

We contribute to the improvement of aviation safety by sharing information and lessons learnt from accident and incident investigations across the aviation community.

opments closely to ensure that we are well prepared to investigate when things don't go to plan. This includes knowing what new hazards there may be at the accident site (such as unstable high-energy storage systems) and how to manage the risks.

The other major area of development that springs to mind is the emergence of artificial intelligence and its potential uses in the aviation domain. We are quite used to investigating occurrences involving highly automated systems in aircraft. But the emergence of autonomous systems and the use of machine learning and artificial intelligence will present a host of new challenges for the investigator to try to establish why the aircraft or air traffic system behaved as it did.

CAN YOU SHARE SOME NOTABLE ACHIEVEMENTS OR MILESTONES REACHED BY THE GROUP?

Over the last 32 years, the group has held 59 meetings and 14 workshops and shared a great deal of knowledge and experience. The ACC members' site is a highly valued repository of presentations, working papers, workshop reports and guidance notes on best practices.

It is also important to recognise that the group has, throughout this period, provided a strong network for mutual support. This is exemplified by the ECAC ACC Code of Conduct. This is a cooperation framework under which any signatory State can request and receive, on a voluntary basis, support from a fellow State during the initial stages of a major investigation. To date, the code of conduct has been signed by 38 ECAC Member States and is almost certainly the most extensive accident investigation cooperation agreement anywhere in the world. ●

Participants attending the 59th meeting of the Air Accident and Incident Investigation Group of Experts (ACC/59) in Paris on 11-12 October 2023

Crispin Orr joined the United Kingdom Air Accidents Investigation Branch as chief inspector in January 2017. He is an active member of the ICAO Accident Investigation Group Panel, and in 2020 was appointed as chair of the European Civil Aviation Conference's expert group on air accident and incident investigation (ACC). Crispin has an engineering degree from Durham University and an MSc in defence technology from Cranfield University, as well as postgraduate qualifications in safety and accident investigation. He is a member of the Royal Aeronautical Society and the Society of Experimental Test Pilots.

Coordinating Committee endorses proposals for upcoming key meetings, and advances cooperation initiatives

PARIS, 27 MARCH 2024

The members of the ECAC Coordinating Committee gathered in March to cover an agenda focusing on preparations for the April meeting of Directors General, to be held in Paris on 25 April 2024 (DGCA/162). The members endorsed proposals for the 2025-2027 work programme and budget. They also agreed to the submission to DGCA/162 of proposals on the treatment of contributions in arrears and on the recording of meetings.

Additionally, they reviewed the progress made by the ECAC Medium-Term Objectives Task Force on the Common Evaluation Process of security equipment (CEP) funding models, as well as the terms of reference and rules of procedure of ECAC working groups. They asked for more detailed proposals to be brought forward during the summer.

The meeting supported, in principle, the proposal for a further one-year no-cost extension of the CASE II Project. This proposal will be submitted to Directors General for decision in the coming weeks.

On external matters, the Coordinating Committee endorsed the proposed agenda for its meeting in Paris with the United States' authorities (CC-US/28, 24 April 2024), and agreed next steps on cooperation proposals with India and Malaysia. ●

ECAC representation at the second Arab environmental forum

MARRAKECH, 26-27 FEBRUARY 2024

The Arab Civil Aviation Organization (ACAO) organised the Second Arab Forum for Environmental Protection in the Arab Civil Aviation Industry in Marrakech on 26-27 February. Deputy Executive Secretary, Mark Rodmell, represented ECAC in a scene-setting opening session, which considered the future trajectory following key decisions made at the 41st ICAO Assembly and the third ICAO Conference on Aviation Alternative Fuels (CAAF/3).

The session also looked at the longer-term role of out-of-sector measures, and the importance of capacity building in progressing towards the long-term global aspirational goal (LTAG) for international aviation of achieving net-zero carbon emissions by 2050.

On the second day, Jesper van Manen (Netherlands) represented ECAC on expert panels addressing sustainable aviation fuels (SAF) and the practicalities of capacity building and other implementation support.

This event showcased strong European representation from a range of agencies, underlining the high level of cooperation between ECAC and ACAO, particularly on environmental matters. ●

ECAC Facilitation Focal Point convenes the Facilitation Programme Management Group

VIDEOCONFERENCE, 20 FEBRUARY 2024

David Benito (DGCA Spain) recently met with the chairs of the Facilitation Working Group and its sub-groups on Immigration and Persons with Reduced Mobility (PRM) for the first time since assuming the role of Focal Point for Facilitation in September 2023.

During the meeting, discussions revolved around the facilitation work programmes for 2024. Particular attention was paid to key ongoing activities aimed at preparing for the ICAO Facilitation Panel in Montreal from 26 February to 1 March 2024. Focus was also placed on the upcoming joint ECAC-ICAO EUR/NAT Workshop on National Facilitation Programmes and Committees, set to be hosted by Greece on 12 March 2024.

The group deliberated on the challenges and opportunities for progressing key issues in ECAC's facilitation agenda over the coming 12 months. It considered the structure of meetings, as well as strategies to advance new areas of work as outlined in commitments made at the end of 2023, such as State-led assistance to air accident victims, and further review of ECAC Doc 30, Part I (*Facilitation*). ●

ECAC experts at the 13th ICAO Facilitation Panel

MONTREAL, 26 FEBRUARY–1 MARCH 2024

ICAO closed its 13th Facilitation Panel session on Friday, 1 March following five days of intensive discussions covering topics from assistance to people with disabilities, air cargo procedures, crew treatment and visas, to the implementation of Annex 9 Standards and Recommended Practices. There was strong regional participation from ECAC Member States with 19 panel members and observers in attendance.

ECAC experts met three times in January and February 2024 prior to the Panel under the European Coordination Group on Facilitation. The purpose of these meetings was to provide support for individual State-nominated experts by sharing views on submitted papers and updating each other on related issues and developments under ICAO's facilitation work programme.

The Panel provided an important opportunity to acknowledge the ongoing work for facilitation in 2024, including under the banner of ICAO's Year of Facilitation 2024.

Decisions were taken on the establishment of a new ICAO group, the Facilitation Capacity-Building Working Group. It was also agreed that the Working Group on Accessibility in International Civil Aviation would consider the topics of assistance dogs and quality assessment programmes within its work programme.

It was, however, also clear from the Panel that there were a large number of ongoing areas of work – including those agreed at the 41st Assembly in 2022 – and challenges that would require further cooperation between States and ICAO to address collectively. The Panel called for more frequent sessions in order to support this, and it was stated that an ICAO high-level facilitation meeting is provisionally expected to be scheduled for the first quarter of 2025. ●

Joint workshop with ICAO EUR/NAT to exchange lessons learnt on developing national facilitation programmes

ATHENS, 12 MARCH 2024

The joint ECAC - ICAO European and North Atlantic (EUR/NAT) Office workshop on National Facilitation Programmes and Committees took place in Athens on 12 March 2024. The event, hosted by Greece, heard opening remarks from Christos Tsitouras – Director General of Civil Aviation, Greece (*pictured*), David Benito (DGCA Spain) in his capacity as ECAC Focal Point for Facilitation, and Nicolas Rallo – Regional Director, ICAO EUR/NAT. Mr Benito emphasised the challenge and complexity that States often faced in developing national facilitation programmes and committees, in the context of having to work across large numbers of stakeholders and in the rapidly evolving and expanding field of facilitation.

Representatives from ECAC Member States shared the lessons learnt during the COVID period and how they had applied these since to review and, where needed, restructure or rebuild their own national facilitation programmes. The importance of recognising factors outside of the aviation sector's control was discussed and participants also received broader perspectives from invited speakers from the International Air Transport Association, Greece's IHR Directorate of Preparedness and Response, Frontex and EUROCONTROL.

Conclusions of the event recognised common factors for successful national facilitation programmes, such as: effective and early information sharing; adaptation of national facilitation committees to fit national needs and to provide benefits for the State as a whole; and ensuring there is clear understanding about all stakeholders and their ICAO Annex 9 roles and responsibilities. It was agreed that as there remain plenty of challenges for States under this topic, consideration would also be given to a follow-up event to share further experiences and gauge progress over the next year or two. ●

Enhanced facilitation practices reflected in 13th edition of ECAC Doc 30 Part I (*Facilitation*)

9 JANUARY 2024

Led by the Doc 30, Part I (*Facilitation*) review subgroup, work was completed in 2023 to update the content of the ECAC policy statement in the field of facilitation to ensure its alignment with current positions.

This review results in key changes in this 13th edition of Doc 30, Part I to reflect amendments to ICAO Annex 9 and related guidance documents, and to reflect evolving facilitation practices in Member States and the industry. Modifications encompass topics such as health measures, Advanced Passenger Information and Passenger Name Record, unruly passengers, trafficking and timely communications.

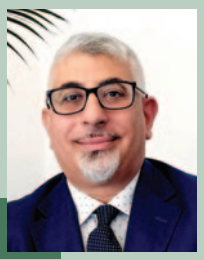
The breadth of topics covered under Doc 30, Part I underscores the extent of ECAC's programme on facilitation, driven by Member States' growing emphasis on matters of common interest relating to immigration and the needs of persons with reduced mobility. ●

ECAC Member State appointments

Eleanor Travers (Ireland) as chair of the Security Forum (SF)

Justo Hernandez Soto (Spain) as deputy chair of the European Aviation and Environment Working Group (EAEG)

Jenny Krüger (Germany) as moderator of the Behaviour Detection Study Group (BDSG)



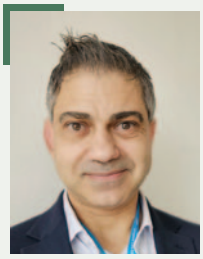
Mark de Laurentiis (Italy) as chair of the Facilitation Sub-Group on the Transport of Persons with Reduced Mobility (FAL-PRM-SG)

Denia Priami (Italy) as chair of the European Coordination Group for Facilitation Matters (ECG-FAL)

Diantha Raadgers (Netherlands) as chair of the State Assistance to Air Accident Victims Task Group (SAAV-TG)

Chiara Cicirello (Italy) as deputy chair of the State Assistance to Air Accident Victims Task Group (SAAV-TG)

News from the ECAC Secretariat



NEW CEP PROGRAMME MANAGER JOINS THE SECRETARIAT

DIMITRIS KYPRIANOU joined the ECAC Secretariat on 1 February as programme manager of the ECAC Common Evaluation Process of security equipment (CEP) following nine years as scientific project officer at the European Commission's Joint Research Centre (JRC).

In this role he managed projects linked to EU policy support in aviation security, threat detection and prevention. He oversaw the quality assurance activities related to the development and production of the European Commission's explosives trace detection (ETD) test kit and explosive detection dogs (EDD) training aids. He was also involved in organising training sessions for end users of those products. Dimitris was an observer in the ECAC EDD Study Group in 2022-2023.

Previous roles in Dimitris's professional journey include as a chemical analyst in the Cyprus National Guard and General State Laboratory and as an R&D analyst in the pharmaceutical industry. His academic background is in chemistry with an MSc in quality control and a PhD in biotechnology.

Dimitris is looking forward to working in the Secretariat and to accomplishing the aims and objectives of the CEP.

A warm welcome to Dimitris!

Events to come

calendar

MAY

9 | 2nd meeting of the State Assistance to Air Accident Victims Task Group (SAAV-TG/2), videoconference
15 | 6th meeting of the Network of Communication Specialists (NETCOM/6), videoconference
16-17 | 56th meeting of the Training Task Force (TrTF/56), London
22-23 | 60th meeting of the Air Accident and Incident Investigation Group of Experts (ACC/60), Stavanger
24 | 50th meeting of the Legal Task Force (LEGTF/50), Paris
29-30 | 7th Environment Forum (ENVFORUM/7), Paris
31 | 40th meeting of the Security Programme Management Group (SPMG/40), Stockholm

JUNE

5-6 | 38th meeting of the Behaviour Detection Study Group (BDSG/38)
6-7 | Preparatory meeting for the diplomatic conference, Paris
10 | 3rd meeting with the regional organisations, Kigali
13-14 | 88th meeting of the Technical Task Force (TTF/88), Riga
17 | 7th meeting of the Network on Diversity and Inclusion in Civil Aviation (NETD&I/7), videoconference
20 | 73rd meeting of the ECAC Medium-Term Objectives Task Force (EMTO/73), Rome

JULY

2 & 4 | 61st meeting of the Common Evaluation Process of security equipment Management Group (CEP-MG/61), videoconference
9-10 | 42nd Plenary (Triennial) Session of ECAC (ECAC/42), Strasbourg
10 | 201st meeting of the Coordinating Committee (CC/201), Strasbourg

Editorial

Dear readers of ECAC News,

As the aviation sector confronts the multi-faceted challenges posed by climate change, it becomes increasingly imperative to implement comprehensive adaptation strategies. The aviation ecosystem faces the dual task of mitigating its environmental footprint while simultaneously adapting to the evolving climate realities. Recent initiatives exemplify the sector's commitment to this critical balance.

For instance, the introduction of more fuel-efficient aircraft and the adoption of sustainable aviation fuels (SAFs) are significant strides towards reducing greenhouse gas emissions. Airlines have made notable investments in SAFs, underscoring the sector's potential to innovate for sustainability. Furthermore, the implementation of advanced operational technologies and practices, such as optimised flight paths, improved air traffic management systems, efficient aircraft designs, and investments in research and development not only enhances efficiency but also contributes to substantial emission reductions.

Airports are also pivotal in the aviation sector's adaptation journey. Resilient airport infrastructure to withstand extreme weather events, sea-level rise, and changing climatic conditions ensures operational continuity and passenger safety. Initiatives like the Airport Carbon Accreditation programme further demonstrate the sector's holistic approach to climate change adaptation. Schiphol Airport in the Netherlands, for instance, has set ambitious targets to become completely carbon neutral, emphasising the sector's role in fostering a sustainable future.

However, adaptation extends beyond technological advancements and operational efficiencies. Collaborative international efforts, such as the International Civil Aviation Organization's (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), are crucial for setting global standards and fostering cooperation among nations and industry stakeholders.

As the aviation sector progresses, it is clear that adaptation to climate change is not just about survival but about thriving in a new environmental paradigm. Enhanced weather monitoring and forecasting, innovation, collaboration, and a steadfast commitment to sustainability are needed for a concerted global fight against climate change.

I hope you enjoy reading this issue of ECAC News. ●

Paula V. de Almeida
JAA TO CEO

A decade of service – interview with former JAA TO Foundation Board chair

In January, after ten years of service, Alessio Quaranta (Director General of ENAC – *Ente Nazionale per l'Aviazione Civile*) made his final visit to the JAA TO in his capacity as the organisation's chairman of the Foundation Board. In a last staff momentum, the outgoing chairman spoke to the CEO and colleagues sharing many good memories and anecdotes. JAA TO spoke to Mr Quaranta for in-depth insights into the organisation's evolution and the future of aviation training under his tenure.

You can read the interesting interview here. ●

JAA TO CEO speaks at ICAO Innovation Fair 2024

In March, JAA TO joined aviation innovators in the discussion on key insights and industry-revolutionising technology on adapting digitalised systems and processes to ensure safe, secure, and sustainable development of aviation. The International Civil Aviation Organization's (ICAO) Innovation Fair brought together innovation clusters, start-ups, SMEs, academia, authorities and regulators all seeking to harness the transformative potential of digitalisation. The event featured panel discussions, start-up pitches and exhibits.

JAA TO CEO Paula V. de Almeida successfully moderated the panel session, *A Digital World: How Can Virtual Reality Unlock the Potential of Innovations in Aviation?*, which gave centre stage for an interesting 90-minute discussion on the importance of artificial intelligence (AI), augmented reality (AR), and virtual reality (VR) implementation solutions for the aviation ecosystem. In an engaging panel conversation between moderator Ms Almeida, the four aviation AI experts and the audience, many futuristic perspectives on the new frontiers of air transport emerged. The well-anticipated session was the highlight of JAA TO's three-day journey to Montreal.

During the first event day, JAA TO's Foundation Board member, Koen Milis (Director General, CAA Belgium), joined other States' decision makers in a panel discussion entitled *A strategy for a civil aviation authority 2.0: digital ideas to serve the transformation into a fast-evolving aviation ecosystem.* Great discussions from directors general on deployment of digital innovations in their civil aviation system. ●

JAA TO CEO chairs ICAO TRAINING Committee

In April, JAA TO CEO Paula V. de Almeida will once more chair the special training advisory committee to ICAO TRAINING, the TRAINAIR PLUS Steering Committee (TPSC), during the ICAO Global Implementation Support Symposium (GISS) 2024 hosted by Instituto Dominicano de Aviación Civil (IDAC).

Under Ms Almeida's chairmanship, the committee continues to act as global reference point for harmonised aviation regulation and training-related matters advising ICAO TRAINING (formerly known as GAT). The TPSC represents all TPP members and seeks to advance many milestones in the interest of the TPP, enhancing safety, efficiency, and global training standards.

The chair joins ICAO TRAINING in continuously promoting the advantages of the network of like-minded aviation professionals and organisations. ●

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