Adapting Aviation to a Changing Climate

Key Climate Change Risks for Aviation

In recent years considerable effort has been put into reducing aviation’s impact on the climate. However even if mankind stopped all carbon emissions tomorrow some climate change impacts are inevitable. Although aviation deals with disruptive weather on a regular basis such events are likely to become more extreme and more frequent as we experience the impacts of climate change. So how can the aviation industry ensure the resilience of our infrastructure and the provision of safe, reliable operations and passenger services in the future?

This factsheet explains some of the climate change risks for aviation and provides a starting point for carrying out a risk assessment for your organization. Please see the resource list and website www.eurocontrol.int/resilience for more information.

Note that these are selected examples only and the significance of these risks will vary according to climate zone, geographical location and type of operations.

<table>
<thead>
<tr>
<th>Climate risk</th>
<th>Impact</th>
<th>Actors</th>
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<tbody>
<tr>
<td>Precipitation change</td>
<td>disruption to operations e.g. airfield flooding, ground subsidence</td>
<td>Aircraft Operators, Airport Operators, Air Navigation Service Providers</td>
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<td></td>
<td>reduction in airport throughput</td>
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<td></td>
<td>inadequate drainage system capacity</td>
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<td>inundation of underground infrastructure (e.g. electrical)</td>
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<td>inundation of ground transport access (passengers and staff)</td>
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<td></td>
<td>loss of local utilities provision (e.g. power).</td>
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<tr>
<td>Temperature change</td>
<td>changes in aircraft performance</td>
<td>Aircraft Operators, Airport Operators, Air Navigation Service Providers</td>
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<td></td>
<td>changes in noise impact due to changes in aircraft performance</td>
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<td></td>
<td>heat damage to airport surface (runway, taxiway)</td>
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<td></td>
<td>increased heating and cooling requirements</td>
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<td></td>
<td>increased pressure on local utilities e.g. water and power (for cooling).</td>
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<tr>
<td>Sea-level rise</td>
<td>loss of airport capacity</td>
<td>Aircraft Operators, Airport Operators, Air Navigation Service Providers</td>
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<td>impacts on en-route capacity due to lack of ground capacity</td>
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<td></td>
<td>loss of airport infrastructure</td>
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<td></td>
<td>loss of ground transport access</td>
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<tr>
<td>Wind changes</td>
<td>convective weather: disruption to operations</td>
<td>Aircraft Operators, Airport Operators, Air Navigation Service Providers</td>
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<tr>
<td></td>
<td>convective weather: route extensions</td>
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<td></td>
<td>jet stream: potential increase in en-route turbulence</td>
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<td></td>
<td>local wind patterns: potential disruption to operations and changes to distribution of noise impact</td>
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<tr>
<td>Extreme events2</td>
<td>disruption to operations, route extensions</td>
<td>Aircraft Operators, Airport Operators, Air Navigation Service Providers</td>
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<td></td>
<td>disruption to ground transport access</td>
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<td></td>
<td>disruption to supply of utilities</td>
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</tbody>
</table>

2 Sudden intense and short-lived precipitation and wind events e.g. storm surges, hurricanes, hail storms, lightning as opposed to seasonal or annual changes

The risks identified above impact the provision of aviation services. However, it is also possible that climate change will impact the demand for those services due to geographical or seasonal shifts in tourist passenger demand driven by changing temperatures and conditions at popular destinations e.g. hotter temperatures or reduced snow-cover. There is currently limited data to assess the risk; further research is required.
Assessing Climate Change Risks for your Organisation

How can you assess whether climate change impacts will be a risk for your organisation? Here are some questions to get started. The case studies provide examples of some of the measures which aviation organisations are already taking to adapt to the potential impacts of climate change.

For more detailed information on carrying out a comprehensive risk assessment please see the resource list and website.

Case Study: Aena - preparing for higher temperatures

In 2012, a joint initiative between the Ministry of Public Works and the Ministry of Agriculture, Food and Environment was launched to conduct a preliminary analysis of the need to adapt the core network of transport infrastructure in Spain to climate change. The work identified higher temperatures as one of the key climate change risks to the core infrastructure network. It then went on to determine which adaptation measures could mitigate this risk.

Key impacts identified include: new airport infrastructure should account for the rise in energy demand for air-conditioning systems in terminal buildings due to increased temperatures; potentially longer runways as higher temperatures mean lower air density, a factor that reduces the thrust produced by the aircraft and the wing’s lift.

Proposed adaptation measures include assessing what additional restrictions the current runway layout may impose on the operation of aircraft in warmer temperatures and the best operating alternatives when a runway requires lengthening and this is not possible. At existing airports the usual practices aimed at reducing risks associated with high temperatures and frost issues should be continued e.g. the pruning and removal of dry vegetation in the vicinity of the airport, or campaigns for the prevention of fires.

However, the impact of both higher temperatures and other climate change risks on the existing airport infrastructure will depend largely on the local conditions and the specific design of such airport. Therefore, it is recommended that an in-depth assessment of the risks posed to airports is launched.

Case Study: London Heathrow - preparing for changing winds and temperatures

As a result of climate change, the UK may experience more extreme summer and winter weather conditions. In response to the disruptive weather, NATS initiated coordination calls three times a day with airport and airline stakeholders. Standard operating procedures remained unchanged. However, the main challenge in keeping the ATC service available was ensuring that staff could work. This was achieved by providing accommodation for key staff at hotels within walking distance of their workplace (e.g. at the airports) and also by using Land-Rovers to shuttle key operational staff between home and work. All key equipment (radar systems and radio communications systems) remained operational throughout the period, despite record breaking low temperatures. NATS assets are designed to operate independently of the national grid (island-strengthening) and NATS maintains a number of suitable vehicles and access equipment to ensure the continuity of service is delivered. This demonstrated that NATS has a suitable strategy in place should such extreme and unexpected snowfall events become more frequent as our climate changes.

Case Study: Avinor - wetter and wilder weather!

Preparing for more water at Norwegian airports

Most of Avinor’s airports are scattered along the rugged Norwegian coastline, with several having runways less than 100 m above sea level. Avinor have been looking systematically into climate adaptation since the turn of the century. But when new legislation was introduced in 2006, requiring safety areas at the sides and ends of runways at several airports to be expanded, theory had to be turned into practice. The seabed close to the runways in question was very deep in some places. In collaboration with technical experts this required looking into projections for future sea levels, wind directions, wave directions and – in some instances – the underwater topography to calculate the size, shape and amount of rocks needed to make robust fillings which would be able to withstand future storms. A procedure was developed for dimensioning criteria for safety areas close to the sea, as well as a set of guidelines for low lying coastal runways and strengthened requirements for potential new runways – they now have to be established at least 7m above sea level.

A comprehensive risk assessment of all Avinor airports, connected navigation systems and surface access to the airports has recently been undertaken.

In general, more extreme weather events, storms and storm surges are expected. Increased precipitation and rare events challenge the drainage systems of airports, aprons, buildings and other infrastructure. During the planning phase of the terminal expansion at Oslo Airport and the related work on the airport, for example, it was revealed that the new drainage systems were in need of 50% added capacity compared with the drainage systems from the 1990s, when the airport was constructed. Amongst other things, it was also discovered that the batteries for some of the NAV equipment are placed on the floor at airports at risk of flooding. This will now be rectified.

Avinor’s experience is that minor adaptation investments in already planned and/or ongoing projects can have positive impact on punctuality and regularity and save on future resources.

Case Study: NATS - Preparing for More Extreme Winter Weather

Snowfall where it’s not expected or which is much heavier than normal causes the most disruption to operations due to lack of preparedness. As heavy snowfall events are currently relatively rare in the UK, part of NATS’ adaptation strategy involved developing a plan to deal with such events should they become more frequent as our climate changes.

The strategy was put to the test sooner than expected in Winter 2010 when heavy snowfalls and record low temperatures brought travel chaos and disruption to Great Britain and Ireland. This led to severe disruption to the road and rail networks with several airports being closed including London Heathrow airport for a time.

NATS respondents

During the period of disruption, NATS managed to maintain a full ATC service with no disruptions. In response to the disruptive weather, NATS initiated coordination calls three times a day with airport and airline stakeholders. Standard operating procedures remained unchanged. However, the main challenge in keeping the ATC service available was ensuring that staff could work. This was achieved by providing accommodation for key staff at hotels within walking distance of their workplace (e.g. at the airports) and also by using Land-Rovers to shuttle key operational staff between home and work. All key equipment (radar systems and radio communications systems) remained operational throughout the period, despite record breaking low temperatures. NATS assets are designed to operate independently of the national grid (island-strengthening) and NATS maintains a number of suitable vehicles and access equipment to ensure the continuity of service is delivered. This demonstrated that NATS has a suitable strategy in place should such extreme and unexpected snowfall events become more frequent as our climate changes.

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Aviation Climate Adaptation Resource List

A selection of resources for climate change risk analysis and adaptation planning. See the website www.eurocontrol.int/resilience for further resources and full document references.

Resources on Climate Impacts for Aviation

Airport Cooperative Research Programme Synthesis: Airport Climate Adaptation and Resilience
Comprehensive review of the range of risks to airports from projected climate change and the emerging approaches for handling these risks.

Provides policymakers across Europe, at different levels of governance and stages of policy formulation, with information that can be used to support adaptation planning and implementation.

EEA/EioNET: Adaptation to Climate Change in the Transport Sector http://cca.eionet.europa.eu/reports/TP_3-2013
Maps current actions in EEA countries for adapting the transport system to climate change and identifies opportunities for further action at the European level in the next years.

EU Adaptation Strategy Package – Adapting Infrastructure to Climate Change
Annex I provides an overview of climate risks and impacts for transport infrastructure, including aviation.

EUROCONTROL Challenges of Growth 2013: Climate Change Risk and Resilience
http://www.eurocontrol.int/articles/challenges-growth
Reviews climate change risks out to 2050 and identifies key actions which the industry can take to reduce those risks.

EUROCONTROL Challenges of Growth 2008: Challenges of Growth Environmental Update Study and Climate Adaptation Case Studies http://www.eurocontrol.int/articles/challenges-growth
Analysis of climate change risks for the aviation sector. Case studies take an in-depth look at the potential impacts of sea-level rise, increased convective weather and climate change-related changes in demand.

Support in adapting to climate change. Access and sharing of information on expected climate change in Europe, vulnerability of regions and sectors, National and transnational adaptation strategies, adaptation case studies and potential adaptation options tools that support adaptation planning.

ICAO Environment Report 2013 Chapter 7: Adaptation
http://www.icao.int/environmental-protection/Pages/EnvReport13.aspx
Series of articles on the possible adverse effects which aviation activity may experience as a result of climate change and the adaptation measures which the sector can implement.

Resources on Risk Assessment for Aviation

DGAC Airport vulnerability on climate change
Overview of climate change risk assessment methodology for airports developed by DGAC France.

Heathrow Airport Climate Change Adaptation Reporting Power Report
Overview of climate change risk assessment carried out by Heathrow Airport Ltd.

NATS UK Climate Change Adaptation Report
Overview of climate change risk assessment carried out by the UK ANSP National Air Traffic Services (NATS).

 http://www.cedex.es/NR/rdonlyres/872032C9-00FB-4DF4-BFA3-63C00B3E8DF1/122814/ACCITFinalReportSeptember2013.pdf
Report on analysis of needs to adapt the core network of transport infrastructure in Spain to climate change, including the core aviation network of 46 airports and two heliports.

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