Climate Adaptation Synthesis Update

By Rachel Burgidge (EUROCONTROL)[1]

Climate change is already affecting weather and climate extremes in all global regions (IPCC, 2021). Global surface temperatures will continue to increase until at least mid-century under all emissions scenarios, which will in turn increase the frequency and intensity of effects such as heat extremes and heavy precipitation. Therefore, while the aviation sector currently operates safely and efficiently in a variety of climates, climate change will pose risks to aviation infrastructure and operations in the future as new climate realities breach the resilience capacity of legacy systems, infrastructure and operations designed for the climate of the past.

To support global aviation stakeholders with identifying the potential impacts of climate change for their organisations and then taking action to adapt and build resilience, during the CAEP/11 cycle the ICAO Committee on Aviation Environmental Protection (CAEP) Airports and Operations Working Group (WG2) produced the ICAO *2018 Climate Adaptation Synthesis Report,* a compilation of information on climate change impacts and adaptation measures for the aviation sector. The Synthesis has become a key resource for ICAO States and aviation organisations to prepare for the impacts of climate change. However, as our knowledge of climate impacts and adaptation measures is constantly evolving it is essential to ensure the content stays current. Therefore, in the CAEP/13 cycle WG2 was tasked with updating the 2018 Synthesis. Experts from more than 20 ICAO Member States and Observer Organisations actively participated in its development during the three-year cycle. This included re-running a version of the CAEP/11 Climate Adaptation Synthesis Report Stakeholder Survey, to see to what extent adaptation action has been taken and whether stakeholder concerns have evolved.

This new edition of the Synthesis, the *2024 ICAO Climate Adaptation Synthesis Report*, provides an updated compilation of existing information on the range of projected climate effects on the aviation sector, and the resulting impacts, to better understand risks to airports, Air Navigation Service Providers (ANSPs), airlines, infrastructure, and other operational factors. The information collected in the report, in combination with climate change scenario projections, will facilitate ICAO Members and Observers, and other relevant aviation stakeholders, in identifying potential effects of climate change which may impact their individual organizations, national aviation sectors and the global aviation network, together with adaptation and resiliency measures that may be beneficial. This is a synthesis of best current information for aviation stakeholders, and not a guidance document.

Updating the Synthesis

The objective of the Climate Adaptation Synthesis is to compile existing information on the range of projected climate impacts for the aviation sector so as to better understand the potential risks to planning, infrastructure, and operations. The working group considered impacts at local, regional, and global levels. It also gathered examples of related adaptation and resiliency efforts and actions that may reduce the risk associated with the impacts of climate change, some of which have already been implemented by States, local authorities, and aviation sector organisations. The science content of the report is based on the findings of the United Nations Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6), and supplemented with other peer-reviewed scientific information.

1 Rachel Burbidge is Co-Lead of the climate adaptation work of Working Group 2 of the ICAO Council's Committee on Aviation Environmental Protection (CAEP).

The update of the Synthesis also involved re-running the 2017 stakeholder survey. An updated version of the survey was sent via State Letter with 259 responses received. There was at least one response from every ICAO Region. The survey asked respondents:

- whether they expect their aviation sector or organisation to be impacted by climate change;
- whether they are already experiencing any climate change impacts;
- which climate change impacts they expected to be impacted by;
- whether they were taking any measures to identify adapt to the impacts of climate change, such as a climate change risk assessment or adaptation measures; and
- how prepared do they think the global aviation sector is for the impacts of climate change and what further action might be considered.
- The key findings from the survey are presented later in this article.

Climate Adaptation Synthesis Content

The Synthesis provides a detailed overview of climate change risk and resilience for the global aviation sector. It contains information on eight physical effects of climate change:

- sea level rise
- increased intensity of storms
- changing temperatures
- changing precipitation,
- changing icing conditions
- changing wind
- desertification
- changes to biodiversity

For each of these impacts, the Synthesis describes:

1. what the physical effect is
2. the expected timescales for the effect to occur
3. the potential impacts for the aviation sector
4. potential adaptation and resilience measures to address the impact

The Synthesis also identifies business and economic impacts for the sector such as potential impacts on revenue or evolutions in air traffic demand due to climate change. Additionally, the Synthesis provides a summary of information on carrying out a climate change risk assessment and developing an adaptation plan. Finally, it provides an analysis of survey responses regarding the preparedness of the global aviation sector to deal with the impacts of climate change.

Climate change is already impacting the global aviation sector

One of the key findings of the synthesis was that 73% of survey respondents are already experiencing climate change, and just five respondents (2 percent) indicated that they do not expect to be impacted (Figure 1). This suggests that climate change impacts are a tangible risk for most of the survey respondents.

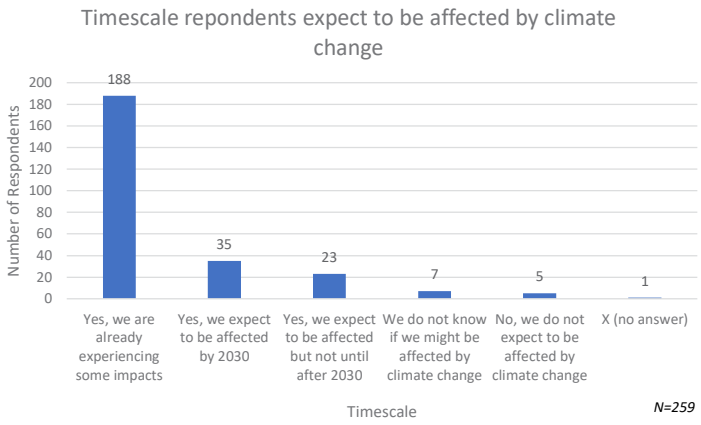

FIGURE 1: Do you expect to be impacted by climate change now or in the future?

Of the nine impact categories included in the survey, the three that survey respondents expect to be most impacted by are:

- **Higher Average and Extreme Temperatures:** 247 of 259 respondents stated they are affected today or expect to be affected in the future by Higher Average and Extreme Temperatures (95 percent). Both average global mean temperatures and extreme high-heat days are expected to increase. The impacts to aviation from higher temperatures are wide-reaching. For example,

high heat days can stress cooling systems or damage the airfield surface if temperatures exceed design standards. Higher temperatures can also reduce air density, which can affect aircraft take-off requirements. Additionally, higher temperatures may cause permafrost to thaw in northern regions, destabilizing infrastructure and contributing to erosion.

- **Changing Precipitation:** 238 of 259 respondents stated they are affected today or expect to be affected in the future by Higher Average and Extreme Temperatures (92 percent)**.** Changes in precipitation type (e.g., rain, snow, hail), as well as precipitation frequency, potentially leading to extreme rainfall or prolonged drought are projected. There is considerable variation in precipitation forecasts globally, but the IPCC AR6 WGI report states that climate change is likely to bring a change, and potential exacerbation, of these conditions to all regions. Extreme rainfall may cause flooding of airport surfaces and infrastructure, while drought may lead to reduced water availability.
- **Increased Intensity of Storms:** 209 of 259 respondents stated they are affected today or expect to be affected in the future by Higher Average and Extreme Temperatures (81 percent)**.** The IPCC AR6 Synthesis Report illustrates how, as temperatures increase, the risk of extreme weather events, such as extreme storminess, will also increase. Increased intensity of storms may cause damage to aviation infrastructure and cause delays or cancelations to commercial air service.

Other key effects and their potential impacts include sea-level rise inundating infrastructure, changes in icing conditions leading to changes to de-icing requirements, changes to wind patterns including changes to the Jetstream which could affect flight times, and an increase in en-route turbulence. There may also be an increase in desertification and a resulting increase in sandstorms disrupting operations, an increase in wildlife hazards due to changes to biodiversity and business and economic impacts such as increased costs from delayed and cancelled flights, or changes to tourism demand.

Climate Change Adaptation and Resilience

The Synthesis also looked at what States and organisations can do to reduce the risks from climate change impacts. It found that the most common approach is to carry out a climate change risk assessment and then develop a climate adaptation plan. This process involves determining how the climate might change in the given area, and what impacts this might have on the aviation sector. The next step is identifying appropriate climate adaptation and resilience measures to reduce the consequences of the climate change impacts identified, and developing a climate adaptation plan to set out and prioritize how those measures will be implemented. For example, adaptation and resilience measures could include increasing surface drainage to counterbalance an increase in heavy precipitation, implementing defenses against sea-level rise or relocating infrastructure to higher terrain, increasing terminal cooling capacity, or re-enforcing infrastructure against stronger and more frequent storms. Of course, any decision on what measures to implement, and to what extent, are an individual state or organisation decision. Finally, given that climate may change differently or more quickly than current projections, it is important to review adaptation plans and measures at regular intervals to ensure the information is current. More detailed information can be found in the ICAO Key Steps in Aviation Sector Organisation Climate Change Risk Assessment and Adaptation Planning guidance.[2]

How prepared are we?

The final section of the Synthesis collates information from survey respondents on how prepared they consider the global aviation sector is to deal with the potential impacts of climate change. For example, 150 of the 259 (58%) respondents considered that the sector has some measures in place but that more needs to be done (Figure 2) and 59 respondents (23%) indicated that that they thought the global sector has considered adaptation but has not yet initiated any actions. These results indicate that most respondents believe the aviation sector has started to take action to adapt to climate change, but that more may need to be done.

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

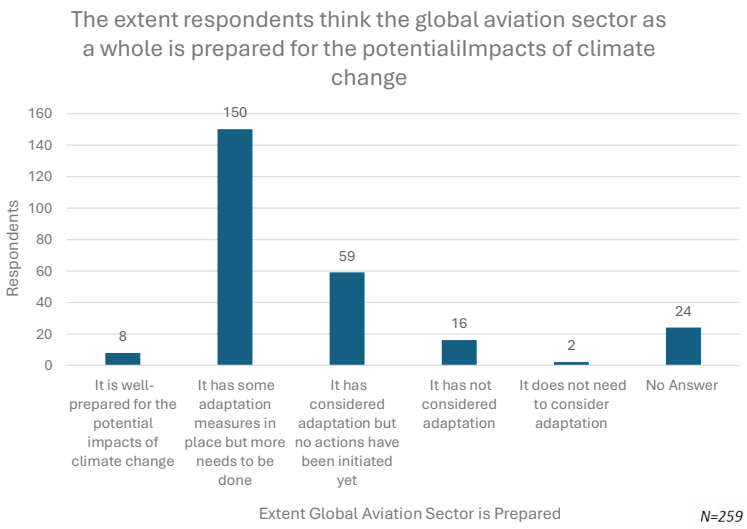

FIGURE 2: Extent to which respondents think the global aviation sector is prepared for the impacts of climate change.

Next Steps

Climate change is a growing global issue. The ICAO CAEP will continue to work on climate adaptation and resilience in the next CAEP cycle, which runs from 2025 to 2028. Of particular note, future work will focus on making information from the Synthesis available more widely, to support the global aviation sector in taking measures to adapt and build resilience to the impacts of climate change. A set of regionally-focused factsheets will also be produced to provide more detailed information at the level of ICAO regions. States and organisations will be able to use this information to support the identification of climate change effects, the potential impacts these effects may have on their aviation sectors and organisations, and to identify potential adaptation and resilience measures to implement to reduce their vulnerability to climate change impacts.