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Committee on Aviation Environmental Protection (CAEP) – Topic 2

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* This paper reflects the author's personal views and cannot be considered as the views of ICAO.

Case: Climate Change Adaptation and Resilience

1. Introduction

Climate change is increasingly affecting aviation worldwide with more frequent and intense extreme weather events, rising temperatures, sea-level rise, and changing wind and precipitation patterns, affecting operations, air traffic control systems, infrastructure, communications, passengers and workforce, e.g., runway flooding, infrastructure damage, flight delays or cancellations. This case examines international approaches to aviation climate adaptation and resilience, ICAO's role and guidance, and the challenges faced by States and aviation stakeholders in integrating climate risk considerations into planning, infrastructure development, and operations.

2. Historical Background

Historically, ICAO's environmental work has focused on climate change mitigation-related issues such as aircraft noise, local air quality, and greenhouse gas emissions. Climate impacts on aviation infrastructure and operations are mainly treated as local or national concerns, and addressed within the UNFCCC framework. ICAO has been integrating adaptation and resilience in ICAO Assembly Resolutions on climate change and into the work of its Committee on Aviation Environmental Protection (CAEP), which increasingly addresses climate risk, vulnerability, and resilience in its technical and policy discussions, including through the development of guidance material.

3. Current Challenges and Developments

Despite growing recognition of its importance, the systematic implementation of climate adaptation and resilience across aviation policies, infrastructure planning, financing, and operations remains uneven. Key challenges include:

- **Lack of knowledge and resources:**
  - Limited awareness and expertise among aviation authorities, airport operators, and other relevant stakeholders.
  - Insufficient financial and human resources dedicated to adaptation and resilience.
  - Limited availability of localized climate projections relevant to aviation infrastructure.
  - Data gaps and uncertainty in climate projections, complicating long-term planning.
- **Limited Implementation and Uneven Progress:**
  - Uneven development of climate risk assessments and adaptation planning strategies.
  - Progress often focused on assessments and planning, with slower implementation of adaptation measures.
  - Difficulty of developing a global approach for issues that are highly dependent on local circumstances and vulnerabilities.

    - Limited monitoring and evaluation frameworks to track adaptation progress and effectiveness.
- **Financing and Investment Barriers:**
    - Difficulty in securing funding for adaptation measures, particularly where benefits are expressed as avoided losses rather than direct financial returns.
    - Competing investment priorities between capacity expansion, mitigation, and resilience.
    - Rising costs, revenue volatility, and increasing insurance premiums linked to climate risk exposure.
    - Limited access to climate finance mechanisms, particularly for developing States and smaller airports.
- **Institutional and Capacity Constraints:**
    - Limited awareness and expertise across aviation authorities and airport operators.
    - Fragmentation of responsibilities between aviation, transport, infrastructure, and climate authorities.
    - Lack of harmonized national and regional policies affecting adaptation and resilience planning.
    - Limited integration of airport climate resilience into broader national climate adaptation strategies.

Airports are particularly exposed due to their fixed, long-lived, high-investments infrastructure. Climate hazards can lead to temporary or prolonged airport closures, damage to runways, taxiways, and terminal facilities, reduced aircraft performance, increased maintenance costs and insurance premiums.

The impacts depend on airports' local context, exposure levels and vulnerabilities. One hazard will entail different consequences depending on the airport's circumstances (geography, regulatory framework, awareness, size, ownership, infrastructure, available resources, etc.), leading to different levels of maturity and readiness in managing climate and disaster risks.

These impacts can undermine connectivity, generate significant economic losses at various levels (airport and aviation industry; local; and national), and compromise the resilience of national and regional transport systems. The need to integrate climate resilience into airport and aviation planning, design, and operations has become increasingly urgent, and the role of ICAO in supporting these efforts is crucial.

4. ICAO's Approach to Aviation Climate Adaptation and Resilience

ICAO promotes a risk-based approach that integrates adaptation and resilience across existing aviation planning and encourages States to address these challenges through planning, cooperation, and capacity-building, while avoiding prescriptive one-size-fits-all requirements. ICAO Resolution requests "[1]"□.

[1] Paragraph 36, ICAO Resolution A42-21, https://www.icao.int/sites/default/files/environmental-protection/Assembly42/Resolution-A42-21_Climate-change.pdf

In addition, aviation adaptation and resilience received significant attention by States and organizations worldwide during the ICAO 42nd Assembly in September 2025, which expressed broad support for further ICAO action on climate change adaptation and resilience, and encouraged the Council to "*develop further guidance materials and assistance initiatives to facilitate the development of aviation climate change adaptation plans by States, while noting the limited resources of the Secretariat to pursue these objectives*"[2].

Key elements of ICAO's approach include:

1. **Climate Risk Assessment and Planning:**
   - Identification of climate hazards, exposure, and vulnerability affecting aviation infrastructure and operations.
   - Integration of climate risk into master planning, infrastructure design, and investment decisions.
2. **Operational and Safety Integration:**
   - Incorporation of climate risks into safety management systems (SMS) and contingency planning.
   - Enhanced meteorological services and early warning systems through cooperation with WMO.
3. **Capacity Building and Guidance:**
   - Development of guidance material, tools, and best practices to support States and industry.
4. **International Cooperation:**
   - Encouraging coordination among States to avoid fragmented approaches.
   - Alignment with broader UN climate adaptation efforts.
   - ICAO emphasizes that adaptation measures must be tailored to local conditions while remaining consistent with international safety and operational requirements.

5. Discussion Points for Students

1. **Accelerating Adaptation and Resilience:**
   - Should climate adaptation be framed primarily as a safety issue, a sustainability issue, or an economic resilience issue for aviation? What are the implications of each framing?
   - What actions or measures should be prioritized to accelerate aviation adaptation and strengthen resilience across the aviation sector?
   - What roles should global organizations, national and regional authorities, and the private sector play in advancing adaptation and resilience efforts?
2. **Role of ICAO:**
   - While recognizing the need to adopt locally tailored, risk-based approaches, what role could/should ICAO play in enhancing global coherence on aviation climate adaptation and resilience?
   - What additional measures or mechanisms could complement ICAO's current approach to build a more robust and coordinated climate adaptation and resilience framework?
3. **Implementation support and Financing Adaptation:**

[2] https://www.icao.int/sites/default/files/Meetings/a42/Documents/WP/wp_688_en.pdf

- How can the aviation sector mobilize and scale investments in adaptation and resilience measures, in a context where financing for climate mitigation remains essential?
- What financial or technical support mechanisms are most effective in assisting developing States and small island developing States facing disproportionate climate risks?
- How should responsibilities and costs for adaptation be shared between public and private actors?

6. Further Reading and Resources

- ICAO Assembly Resolutions on Climate Change
- ICAO Environmental Report – Climate Adaptation and Resilience
- 2024 ICAO Climate Adaptation Synthesis Report, which also includes a series of Factsheets describing potential climate change impacts to aviation.
- Guidance material on Climate Risk Assessment, Adaptation and Resilience
- ICAO Eco-Airport Toolkit e-Publication, " Climate Resilient Airports"
- ACI Policy Brief on Airports' resilience and adaptation to changing climate, 2018
- ACI APAC-MID Tendering Guideline for climate resilient planning, 2022
- ACI LAC Study on Adapting Airports in Latin America and the Caribbean to a Changing Climate, 2024
- ACI Europe and Eurocontrol, Briefing on Adapting Aviation to a Changing Climate, 2024
- ACI Europe and Eurocontrol, Guidance on Risk Assessment and Adaptation, 2025
- Coalition on Disaster Resilient Infrastructure (CDRI), Five steps guidance
- CDRI, Global Study on disaster resilience of airports on the current state of practice of disaster risk management and resilience, 2023 including regional insights.